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An Obsolete Unit

DESPITE the fact that the barrel as a container for cement has disappeared, except for export trade, we still continue to use the unit, "the barrel," in ordinary conversation and in purchasing this material. The use of cement, however, is based on the sack, or upon a weight which is translated into a sack equivalent, while all shipments from mills are in cloth or paper instead of wood. There is no excuse for retaining the old designation, except custom and, possibly, some little difficulty in interpreting statistics rapidly growing musty with age. Is it not time that the barrel unit be discarded and all purchases, as well as the use, be based upon the sack? It may be contended that, all accidentals aside, the logical unit would be one of weight. That is true, but since concrete materials are now mixed by volume, and will probably continue to be mixed in this manner for a long time, it is convenient to have a volume unit. Logically, cement should be bought by the pound or the ton, but convenience is served by some volume measure of convenient size. For present purposes the sack now used gives satisfaction, and it might well become the accepted and only unit, keeping for it always a definite and accepted equivalent weight.

The Eastland Horror

ONE CANNOT escape the conviction that some time, in fact, more than once, in the Eastland's cranky history, engineers—naval architects is their general designation—were at fault or their advice was disregarded. As a consequence, the craft which as many as eleven years ago occupied columns in the Chicago newspapers, because of its crazy behavior, carried to death twelve or fifteen hundred people right within arm's reach of assistance. The world was shocked at the sinking of the Titanic, with its terrible toll of lives. There was some criticism of the action of the captain in running at high speed through a region known to be harboring icebergs, yet the ship itself had never been the object of suspicion nor was there any way in which public authority or engineering skill might have foreseen the disaster. In the case of the Eastland, however, it is unescapable that there was ample warning as to the unseaworthiness of the vessel. If it was not fully examined by competent naval authorities, those responsible for the failure to have the examination made should be punished. If the examination was made and the vessel was reported unseaworthy, then those entrusted with the enforcement of the law deserve to go behind prison bars. The third alternative is that the engineers, or naval architects, making the examination erred—a possibility but not a probability, especially in view of such statements as have already been made regarding the limited passenger-carrying requirements imposed some years ago upon the vessel. The point of special interest to engineers, however, is that upon them, in the last analysis, rests the safety of people traveling whether by water or rail. If their judgments are competently rendered, and the laws strictly enforced in accordance thereto, disasters of the Eastland type cannot be repeated.

Elevated Railway Humps

A DIFFICULT problem confronting the engineers of the Interborough Rapid Transit Company in the third tracking of the existing elevated railways in New York City, now approaching completion under the so-called Dual-System contracts, has been met by a very simple and effective solution. The article on page 138 of this issue describes the "hump" construction adopted at the express stations to provide access to the new center express track. The widening of the structure would have been very expensive, and the solution offered is not only practicable and economical in construction, utilizing existing center-track stringers, but should prove economical in operation. A very large percentage of the motive power is ordinarily lost in accelerating on leaving stations, while braking is an expensive operation. Deceleration will now be aided by the ascent of the hump, while less power will be needed in leaving stations, due to the down grade. Costs of operation on these center tracks will allow interesting comparisons to be made with the operation of lines having stations on level stretches. If the figures are as favorable as they are expected to be, they may indicate future possible economies not only on intraurban elevated, but also on electrified suburban lines.

Saving Through Expensive Tools

THE AMOUNT and kind of plant most economical for the road contractor has been receiving increased attention this year, because the slackness in other lines has brought many new competitors into this field. Some years ago while the paving contractor was buying concrete mixers and asphalt road machinery, the road contractor was still operating with a scraper outfit and the old blade grader. An attempt to use an expensive tool like a steam shovel on a road or pavement contract would have been looked upon as the height of folly. At that time, old pavements that had to be removed were torn up by hand methods, and practically all transportation of spoil and surfacing materials was by team. Recently the use of tractors to pull improved types of scrapers and elevating graders, the use of automobile trucks, traction trains and industrial railways to transport road materials, and the development of a type of steam shovel that is able to dig shallow cuts and old pavements with great economy, have revolutionized the business of the road and paving contractor. These new tools are described, the conditions under which each may be employed are given, and the money-saving and revolutionary methods of road building brought about by their use are outlined in the article on page 126 of this issue. In no contracting field at present are a greater number of changes in construction methods being made than in road and paving work, and the contractor who would progress must use every means to keep abreast of developments.

Eliminating Labor

CONSTRUCTION problems involved in the building of concrete roads and the laying of bases for other types of pavement have been given unusual consideration within the last few years. Rightfully so, too, because of the volume of this work and the high expense of repeated rehandling of the materials. Loading devices and discharging arrangements especially adapted for paving work were among the first of the big steps forward, and, simultaneously, contractors experimented with various methods of transporting materials from cars, pits and quarries to the roadside. What economies have been effected are pretty well known to the readers of this journal, through the numerous articles on highway construction. In this issue there is an account of a concrete road job in which the materials were mechanically handled from the pit to the road. Except in one particular, there are no special departures in the equipment used. The contractor has merely assembled wisely ideas quite common in construction work. Their combination has resulted in reducing labor costs very materially. The novel departure consists in using a side-loading instead of an end-loading mixer, but this comparatively slight change has solved what has always appeared to this journal to be a wasteful procedure, namely the depositing of sand and large aggregate on the subgrade and its necessary rehandling to the loader of the mixer. Without a doubt the combined ingenuity of contractors and manufacturers of road-building equipment will result in still other advances in the near future. In this connection, and by way of closing, it is not out of place to point out how largely the manufacturers of equipment have contributed to the cheapening of all classes of road construction. The engineer may well plume himself upon improvements in design, but these alone would have left the present road-building era far in the future. It is the cheapening and betterment of equipment and the invention of new devices, requiring the investment of hundreds of thousands of dollars by way of experiment for their development, which are responsible for the cheapening of our highway work. The manufacturers, no less than the engineers, have played an important part in highway progress.

Psychology of the Chalk Line

QUITE a number of cities at present are trying to enforce traffic regulations which require pedestrians to cross streets only at intersections, and a number of them have adopted an ocular persuasive measure, consisting in the painting of lines across the streets at intersections, designating the boundaries within which crossing is permitted. At first sight it would appear that this simple expedient would be of little value. Brief observation, however, in one of the cities where the scheme has been tried indicates that the painted marks do have an influence upon the pedestrian traffic. Probably this is due to the fact that violation of the traffic ordinance—by crossing the street in the middle of a block—is due in most cases to thoughtlessness. Consequently, if at every intersection the pedestrian is reminded by the white—or in some cases red—marks that these safety spots are provided for his protection and in accordance with the law, he is apt to cross to the other side when this thought comes to mind instead of waiting until he is in the middle of the next block. Even with those who cross indiscriminately because they are indifferent to the law, the constant recurrence every 300 ft. or so of reminders that they are violating the law must in time have a restrictive influence. Eventually the use of these markings may be unnecessary, after crossing only at intersections becomes a habit with those who frequent business sections, but certainly as an educative means their use at intervals is well worth while.

Straight Talk for the Contractor

THE SECOND volume of a work by D. J. Hauer, on the economics of contracting, just issued, meets squarely and answers in the plainest and broadest manner the questions of handling and training men, planning construction work, financing a contracting business, and conducting it so as to avoid a needless legal and financial entanglement, and to gain the confidence of the public. These are matters on which the individual contracting business must stand or fall. It is along these lines that contracting is being led by its broadest men to a much higher plane of efficiency and usefulness than it has ever occupied. The basic principles laid down in this book are such as the Engineering Record has stood for and consistently attempted to hammer home. The contents of this work should be brought to the attention of every contractor in the country. Some additional notes on it will be found in the literature section of this issue.

Disorderly camps, and the practice of robbing men through poor food, exorbitant commissary prices, and short time, are going out of fashion. Almost everyone recognizes that these practices hurt the contractor seriously. Much remains to be done, however, in housing and caring for men out of working hours, both in the city and in the "sticks," so that their bodily and mental health will be increased. These factors are vitally reflected in the attitude of the men toward their work, which has everything to do with their efficiency and cash value to the contractor.

Allied with these questions is the liquor and saloon problem, which every contractor has to face. There is no doubt that this evil has dragged down the efficiency of a high percentage of the class on which the contractor must depend for his supply of mechanics and laborers.

Training men and playing fair with them when they have proved their worth are questions which are newer to contractors. They are of special importance at present when the organization that is trained and loyal from laborer to chief executive is taking the business and making the records and the profits. One Eastern contracting firm which considers itself up-to-date and attempts to train its own men has lost several of its most brilliant pupils through a parsimonious policy. Certain heads of this firm have each their own clique, and have taken every opportunity to browbeat several promising superintendents not of their personal following and to lay these men off at the ends of jobs, or refuse to pay them properly for their services. The company, of course, lost these men just as they were becoming of real value, and turned over to their competitors a lot of first-class construction brains trained at their expense.

Open and honest dealing with a contractor's customers, sub-contractors and creditors, which is backed by sound legal and business advice, is more widely appreciated. Fortunately the man who makes his living by defrauding owners and creditors is becoming scarcer. The man who gets into financial and legal troubles unnecessarily by failing to handle his creditors and his income properly, or by failing to consult such legal and expert advisors as are able to prevent his being imposed upon, is still with us. Such men must be educated, or their forced exit from the field will injure others beside themselves.

The relation of the contractor to the public is another important question well dealt with in this book. Proper publicity methods cannot but improve the standing of the business and increase public confidence in contractors.

Mr. Hauer hits straight from the shoulder and says many things that contractors may not like to hear. It is good for them, however, to hear them, for a time is coming when only those who know the principles he advocates and apply them will be able to succeed.

Following Materials Into the Field

IT IS patent that the ultimate test of any machine or material is the service that it renders when applied to the work for which it was designed. And yet, despite the fact that no one will deny the truth of the statement, manufacturers can be found in many lines who apply the acid test of field service to their product only when, through serious failure, they must replace the machine or supply a substitute for the product that has failed. Their interest, so to speak, is a trailing rather than a leading one. Instead of making a thorough analysis of the conditions under which their product will be used and insuring by careful study that it will be adequate for its purposes, they proceed on fragmentary data, trusting that they will guess right and that such failures as will occur will not be serious enough to cause them great financial loss. Of course, it is not always possible to see all of the conditions that will apply when a certain device is in service, and some measure of adjustment and modification must be expected even after the most painstaking design. Nevertheless, the changes and alterations in most American machines after they have first been placed on the market far exceed those that would be necessary were adequate consideration given in the first place to the conditions under which the product would be used.

Another weakness of many manufacturers is that they take volume of production and sales as their standard and not "service" to their customers. They will not hesitate to sell a material even if it is not adapted to the use in question. This practice in the selling of pavement materials has been criticised in this journal in the past. Progressive manufacturers have long since adopted the policy of refusing to sell their products for purposes for which they are not adapted.

This journal has noted with satisfaction the extent to which manufacturers selling equipment and materials to engineers and contractors have grasped these new theories of business getting. There is still tremendous room for improvement, but that should not lessen appreciation of the progress that has been made. Readers of the Engineering Record will recall the extensive inspection work being done by the cement manufacturers, individually and through the American Association of Portland Cement Manufacturers, on concrete road work. They feel that the best assurance of future prosperity in their industry is the intelligent education of cement users in the use of their product. A poor concrete highway, for example, deters others from using concrete in road work, and, in general, any misuse of cement reacts against it, even though the fault is due not to the material but to the builder or user. In the brick pavement line, the Dunn Wire-Cut-Lug Brick Company has proceeded on the same principle and maintains an engineering staff, whose duty it is to see that the blocks produced by their licensees are correctly used. Now comes the announcement that this company has employed a ceramic engineer, whose business it will be to confer with the plants making wire-cut-lug brick, to learn their difficulties and help them solve their problems.

This spirit needs to be injected in every commercial line contributing to the construction of engineering work. It means a large gain to the public, and at the same time is the best policy, in the long run, for the manufacturer. He gains nothing by selling an inferior product or a good product for an improper use. In fact, such a sale inevitably sets him back and gives him a handicap not easy to overcome.

The Stability of Public Utility Investments

RECENT advances in industrial securities closely identified with the filling of war-material orders have caused holders of public-utility stocks in some instances to question the future of their investments. The decrease in the market price of the latter, which has been sympathetic with world-wide conditions, has led to the inquiry whether the holder should sell at a loss in the belief that present conditions are likely to continue or should retain his shares in the faith that brighter days will come. The Boston *Transcript* has rendered a service in a recent discussion of this matter, and rightly concludes that the holders of public-utility securities have no real cause for apprehension, in view of the inherent soundness of the properties engaged in supplying gas, electric and transportation service in this country.

The war in Europe came as a climax to a period of generally unsatisfactory business conditions, and naturally aggravated them in an unprecedented manner. Securities of street railway, gas, electric light, power and railroad companies all were affected to a greater or less extent. Gradually the stimulation of industries engaged in the manufacture of supplies for belligerent nations began to create a special demand for industrials of that nature. The speculation encouraged by a bull market distracted the attention of many investors from securities which had been considered fundamentally sound and not subject to wide fluctuation.

Earning power is the final test of a property, and so far as electric light, power and gas companies are concerned, they are unquestionably holding their own and in some cases are doing better than a year ago. The advent of the jitney bus has injected an element of uncertainty into the street-railway industry, but in view of the economic difficulty of rendering local automobile service at existing rates and the certainty of a greater measure of regulation, the street railway will remain an indispensable factor in local transportation, and it is inconceivable that public support in the long run should not be accorded it. The tendency in railway and other utilities is undoubtedly toward rates permitting a reasonable return upon the invested capital, and there is as yet no clear evidence, despite the Alaskan railway venture, that the American people prefer government ownership in any form to private ownership under governmental regulation. Public utilities have by no means reached the height of their usefulness, and, with the advent of improved business conditions, increased efficiency in serving the public and a broader expansion of service will create a better popular understanding of the inherent strength of well-managed public utility and railroad companies.

The Changed Reclamation Service

SLOWLY, but none the less surely, the U. S. Reclamation Service has been passing through most momentous changes. It will be remembered that at the very beginning of the present Federal administration it was intimated that politicians would "get" those who had headed the service for so many years. It is commonly believed that the opposition to Mr. Newell and Mr. Hill came with such force that, for the moment at least, the new Secretary of the Interior, Mr. Lane, was almost swept from his feet and much in doubt as to what move should be made. In this difficult situation he did the best thing possible—called a conference in Washington, at which the objectors were allowed to state their case. In order to estimate the strength of what might be termed the prosecution, the Engineering Record had a representative at the hearing, and his report was summarized in this journal at the time, showing clearly that the disgruntled water users failed to make a case. It then appeared for a time that there would be comparatively little change in the organization, but not long thereafter the commission management was substituted for that of the director. For a time this appeared to be just a perfunctory arrangement, and matters seemed to be handled much as in the past, with only the inevitable delay at Washington due to commission control.

But there were other movements under way, and one by one important men began to resign, because of interference in their work or other conditions which made their tenure of office distasteful and unpleasant. Finally Mr. Newell's resignation was accepted.

But influences were also at work from another direction, and, as readers of this journal well know, the Reclamation Service, heretofore independent of Congress as to the disposition of alloted funds, was put in the pork-barrel class, and now, with rivers and harbors and public buildings, will be a bone of contention for hungry and—why not tell the truth—"unscrupulous" congressmen, for it is unscrupulous, in the opinion of this journal, to get hundred-thousand-dollar post-offices for ten-thousand-dollar cities and to improve rivers and harbors out of all proportion to their relative importance.

Finally, as a last straw, has come the opening of the Denver office, and the concentration there of supervision of projects heretofore closely controlled in six districts. The result of the last change has been the virtual loss to the Government of veterans whose knowledge and initiative was invaluable to the Government, who every year saved their salaries many times over and whose places cannot be effectively filled without long and costly apprenticeship. Although not all of these engineers have been actually dismissed from the service, the reduction in rank which they have suffered means the same thing in many instances. It is apparent that the old esprit de corps of the organization has been killed, and naturally these engineers will find no interest in their lessened responsibilities and will leave the service when they can do so conveniently.

The final step in the reorganization has been made under the guise of economy, but it is difficult to see where this move will mean economy in the long run. Its first and most serious defect is the elimination of a few comparatively high-salaried officials, but it is impossible to conceive of a great manufacturing company or any large private interest adopting a policy of reducing expenses by discharging its department heads. Their salaries in the aggregate are but a fraction of what must be saved annually to show any material reduction in manufacturing costs, and, on the other hand, without their services the quality of product drops rapidly, efficiency is lowered, the rate of production decreases, and the management is lucky, indeed, if at the first serious difficulty the wheels do not stop altogether.

The Engineering Record does not impugn the motives of the present Secretary of the Interior. It believes he has been mistaken in his judgment, but it hopes that the reorganization he has brought about will not turn out to be disorganization. Without a doubt he has felt it obligatory upon him to make changes—changes which he believes will result in greater efficiency. Though this journal, in principle, favors individual rather than commission control, both the changes in Washington and the establishment of the Denver office are not necessarily foredoomed to failure. The changes are, however, disquieting to those who have followed with care the effective work of the service during the first ten years of its existence. Too much has now been conceded to the disgruntled elements in the West, to those who would like to get something for nothing from the Government. The country will await with anxiety proof that the service has not been disrupted.

For the Congressional blundering, one cannot entertain even hopes. The throwing of the service into the pork barrel will make it a political football, while the lengthening of time for payment of water rights was a concession to the elements that are never likely to make a success of irrigation farming. The work of the service has been made infinitely harder by this Congressional mismanagement.

Taken as a whole, therefore, this journal cannot escape the conclusion that the administration has blundered badly with reference to the Reclamation Service. It hopes for the best from those changes which can be justified by skillful administration and organization building. It despairs of any relief from the absurd conditions imposed by Congress, abetted, at least, by the executive branch of the Government.

Operation Analysis of New Machines Which Cheapen the Moving of Earth on Road Work

Light Steam Shovel Proving Efficient in Cuts of Moderate Depth, and in Removing Old Paving and Surfacing—Cost of Operating Dirt-Handling Machines

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IN HIGHWAY CONSTRUCTION it is necessary that the proper methods and machinery be used to secure economical and efficient results. The light, portable and adaptable types of excavators are the best suited for the varying conditions and light work of road and street construction. Each machine has its own peculiar sphere of usefulness and its most economical method of operation. A quarter of a century of experience has shown, especially in the Middle West, the value of blade and elevating graders in road grading and shallow excavation. Recent experience has developed a large-capacity wheel scraper, which is very efficient for hauls greater than 300 ft. A specialized form of the steam shovel has recently proved its usefulness in shallow cuts, and especially in the excavation of hard materials.

Four-Wheel Scraper

A four-wheel scraper, made in two sizes, ½ and 1-yd. capacities, is proving to be very efficient in road and street excavation. The machine consists of a pan which is hung by chains from a steel frame supported on two trucks. The front wheels are underhung to permit of short turns. The pan, the front edge of which just touches the ground in the loading position, is operated with four levers by the driver, who is seated at the rear of the machine. A snatch team or traction engine is used in loading. The pan, when filled, is automatically elevated by a sprocket chain while the machine is in motion. The load is dumped through a gate in the rear of the pan.

This machine, known as the Maney four-wheel scraper, has only recently been used in road construction. It has, in several cases, with the soil conditions varying from a dry sand to a hard, dense clay, proved its adaptability and efficiency in this kind of excavation. The writer has made a study of the use of this machine in the excavation of the subgrade for street pavements in cities in central Illinois. The soil conditions were generally favorable—loam and clay, with occasional sand and fills of ash and cinders. The width of cut averaged 20 ft. and the depth of cut from nothing to 18 in., with an average of 12 in. The average length of haul was about 300 ft. and on nearly level ground. Each scraper was hauled by a two-horse team and loaded by a traction engine. Table 1 is an estimate of the average cost of excavation, based on the use of seven scrapers and one traction engine for a ten-hour day.

TABLE 1—COST OF EXCAVATION WITH FOUR-WHEEL SCRAPER

Labor	
2 firemen, at $3	$6.00
1 cableman	2.00
7 teams and drivers, at $5	35.00
Total cost of labor per 10-hr. day	$43.00
Cost of labor per cubic yard excavated, $43/800	$0.053
Loading Auxiliary	
1 traction engine and operator	$16.00
Cost per cubic yard excavated, $16/800	$0.020
General and Overhead Expenses	
Supervision and general expenses	$3.00
Interest on investment (7 per cent of $1,800)	0.62
Depreciation, based on 5-yr. life	0.88
Repairs, estimated	1.00
Total general and overhead expenses	$5.50
Cost per cubic yard excavated, $5.50/800	$0.007
Total cost of work per day	$64.50
Total amount of excavation, cubic yards	800
Cost of work per cubic yard excavated, $64.50/800	$0.08

The four-wheel scraper is from 50 to 100 per cent more efficient than the two-wheel scraper for hauls of 300 ft. and over, and the efficiency increases with the increase in the length of haul. The scraper under ordinary conditions has an average speed of 120 ft. per minute, including time of dumping. With a traction engine about sixty scrapers can be loaded per hour under average conditions of soil, haul, etc. A 1-yd. scraper should average about 12 cu. yd. per hour or 110 cu. yd. per ten-hour working day. The cost of excavation, including overhead expenses, should, under average conditions, vary from 7 to 9 cents per cubic yard for a 200-ft. haul, and increase about 1 cent per cubic yard per 100-ft. increase of length of haul.

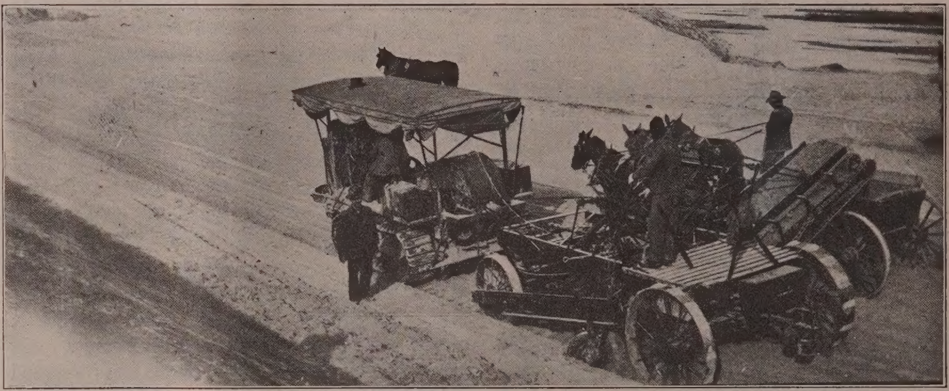
This type of excavator is not adaptable to the final grading up, crowning and surfacing of the excavation or subgrade. Some form of road or scraping grader should be used for this finishing work.

Blade Grader on Road Work

The blade or scraping grader is a time-honored and much used and abused machine for the construction and maintenance of earth roads. Its use and method of operation are so well known that it is unnecessary to discuss them here.

A great deal of difficulty has been experienced in the use of a road grader on the construction of earth roads, especially in stiff clay soils, in preventing the displacement of the machine due to the lateral thrust of the earth. Recently a type of grader, which was originally devised for ditch excavation on reclamation work, has been found to work advantageously under adverse conditions of road construction. This type of grader has pivoted axles so that the wheels can always be kept in a vertical position. Thus the weight of the machine is utilized to counteract the side pressure of the earth on the moldboard and prevent side draft. Where a large amount of road construction is included in one job it is economical to use a traction engine for hauling the grader. Two graders may be hauled by one engine and thus serve to move the earth from the ditch to the center of the road at one trip.

In a case of road construction in Van Buren County, Iowa, the tractor was a 60-hp. gasoline engine and the graders were the so-called Reclamation graders. Sixty miles of earth road was built at a cost of $20 per mile. The road measured 30 ft. from center to center of the side ditches, which had a width of 20 in. and a depth of 36 in. The earth was the ordinary loam and clay of the prairie country.



THE ELEVATING GRADER, DRAWN BY TRACTOR, IS EFFECTIVE ON WIDE ROADS

Elevating Grader for Wide Roads

The elevating grader has been universally used on road construction in this country during the last quarter of a century. The ideal conditions for its use are in a prairie country which is fairly level and where few stumps and rocks exist to hinder the progress of the plow. It is a more economical machine than the blade grader in road construction, since the excavated material can be moved as cheaply 24 ft. as 10 ft. from the plow at one operation, while with the blade grader the distance to which the earth can be moved is limited by the length and set of blade. However, in the regrading of old roads where the side ditches are narrow and deep, the elevating grader is not serviceable and the blade grader should be used. As is the case of the four-wheel scraper, the elevating grader leaves the grade rough and uneven and a blade machine must be used to finish the surface.

The writer has been surprised to find that a great many contractors do not appreciate the economy in the use of power tractors for the haulage of grading machines. In order to make this distinction clear, the accompanying comparative statement (Table 2) is given. This is based on average working conditions on road construction in comparatively level country. It is also based on the excavation and removal of the earth from the side of the road to the center. When it is necesary to carry the earth along the road, as in the making of cuts and fills, dump wagons must be used. For a haul of 300 ft. one elevating grader can handle five- 1½-yd. wagons, and one additional wagon is needed for each 100 ft. additional length of haul. The cost of a wagon and driver will be $5 for a ten-hour day. A foreman at $3 per day will probably be necessary both at the excavation site and at the dump. Hence in this case the cost of excavation will be increased to from 8 to 12 cents per cubic yard.

STEAM SHOVEL PROVING EFFICIENT

The steam shovel is one of the most efficient and universally used of all modern excavators. The original type of shovel with fixed platform has been generally employed in cuts deeper than 5 ft. when the yardage was sufficient to warrant its use. Highway construction, however, usually involves the excavation of a succession of light cuts with depths varying from a few inches to a few feet. Hence the steam shovel has been little used on road construction until the advent of the revolving shovel in recent years.

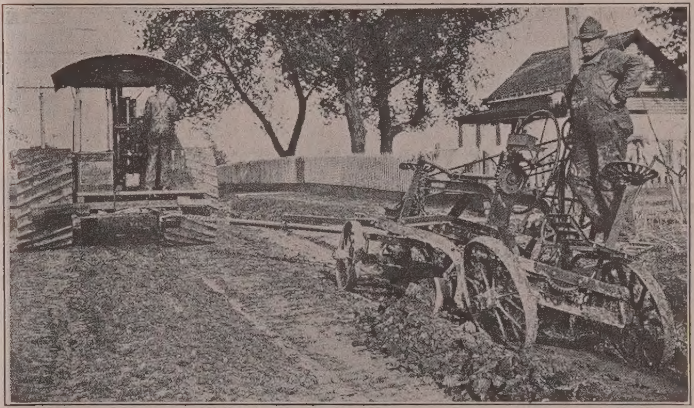
LEFT: TRACTION ENGINE MAY BE USED TO DRAW A NUMBER OF BLADE GRADERS

TABLE 2—COMPARATIVE COSTS OF EXCAVATION WITH ANIMAL POWER AND GASOLINE TRACTOR

Animal Power		
7 teams, at $2.50	$17.50	
2 drivers, at $2.50	5.00	
1 operator	3.00	
Total labor cost		$25.50
General:		
Interest on investment at 6 per cent	$1.20	
Depreciation, based on 10-yr. life	2.00	
Repairs and general expenses	1.30	
Total general expenses		4.50
Total cost for 10-hr. day		$30.00
Excavated per day		800 cu. yd.
Cost per cubic yard		3.75 cents
Gasoline Tractor		
Labor:		
1 engineer	$5.00	
1 operator	3.00	
Total labor cost		$8.00
Power:		
Gasoline, 30 gal., at 15 cents	$4.50	
Cylinder oil, 1½ gal., at 36 cents	0.54	
Grease, 2 lb	0.20	
Repairs, waste, etc	0.76	
Total power cost		6.00
General:		
Interest on investment at 6 per cent	$2.40	
Depreciation, based on 10-yr. life	4.00	
Repairs and general expenses	1.60	
Total general expenses		8.00
Total cost for 10-hr. day		$22.00
Excavated per day		1000 cu. yd.
Cost per cubic yard		2.2 cents

The revolving shovel is a machine of small capacity, light weight, rapid action and easy portability. The principal features of this type of shovel are the full-circle swing and separate hoisting, swinging and crowding engines, the last of which provides for thrusting the dipper forward into the earth and prying up hard materials. Its especial adaptability to highway construction of all kinds has been proved by its efficient excavation of cuts from 6 in. to 15 ft., of all classes of earth, and of street pavements and hard road surface materials, and by its ability to operate over grades up to 10 per cent, make cuts to a smooth and uniform grade and side slopes, and load cheaply into wagons, or overcast in sidehill work.

The average engineer or contractor, even at the present time, conceives of the economic field of the revolving shovel as in heavy excavation only. However, the experience of many contractors during the last two years has clearly demonstrated the efficiency and economy of the use of the revolving shovel in very shallow excavation, such as excavation for street pavement foundations and the removal of old street surfaces and pavements. Four typical examples of such work will be cited as evidence in substantiation of the truth of the above statement.



RIGHT: WHEELS TILTED ON PIVOTED AXLES TO TAKE UP THRUST OF BLADE

PERFORMANCE OF SHOVELS IN SHALLOW CUT

Three revolving shovels, one with a ⅝-yd. dipper and two with ¾-yd. dippers, were used in street grading in Minneapolis during 1914. The material excavated was the ordinary loam and underlying glacial clay, prevalent in the prairie States. On the ordinary grading work, with an average haul of 300 ft., the cost of excavation, hauling and dumping was 15 cents per cubic yard with 1½-yd. dump wagons and 11 cents per cubic yard with cars.

A Thew revolving shovel, equipped with a ⅝-yd. dipper was used in the excavation of the street surface preparatory to paving. The material of the street surface was a very hard, dense clay mixed with boulders. The use of a heavy pavement plow had been found to be impracticable on account of the extreme compactness and hardness of the surface. The average cut was 1 ft. and the excavated earth was dumped directly into 1½-yd. bottom dump wagons.

TABLE 3—COST OF STEAM-SHOVEL WORK AT MINNEAPOLIS

Labor		
1 engineer	$6.00	
1 fireman	2.50	
2 laborers, at $2.50	5.00	
Total labor cost		$13.50
Fuel		
Coal, ½ ton, at $6	$3.00	
Oil, grease and waste	0.15	
Repairs and overhead charges	1.05	
Total fuel cost		4.20
Total cost of excavating 250 cu. yd		$17.70
Cost of excavation of 1 cu. yd., $17.70/250=		$0.07

The cost of excavation under average working conditions for an eight-hour day is given in Table 3, the data being furnished by F. W. Cappelen, city engineer of Minneapolis. The cost of 7 cents is the average cost of 1 cu. yd. of excavated material in the wagons, ready for haulage to the dump. An inspection of the data shows that an average hourly excavation of 31¼ cu. yd. was attained. This excellent record indicates efficient shovel operation and few delays for repairs or waiting for wagons.

The second instance is taken from the contractor's record for street grading in preparation of the subgrade for pavements in Lexington, Ky. The excavator used was a Thew revolving shovel equipped with a ⅝-yd. dipper. The material excavated was a packed clay and loam surface material. Ordinary delays, such as moving up and waiting for teams, were not considered in computing the number of operating hours. Time was deducted, however, for delays due to causes foreign to the work. The average depth of cut was 10 in., total operating time 60 hr., total length of excavation 1788 ft., total excavation (place measurement) 1445 cu. yd. and number of teams used, ten. This gives an average of 24 cu. yd. excavated per hour.

The third instance is that of a Bucyrus revolving shovel, equipped with a ⅝-yd. dipper, which was recently used in street pavement work in Ogden, Utah. The contract included the removal of eight blocks, or 22,500 sq. yd., of concrete pavement about 10 in. thick. The shovel removed a section of concrete slab 600 ft. long and 20 ft. wide,

TABLE 4—COST OF STEAM-SHOVEL WORK AT OGDEN

1 foreman	$4.50
1 engineer	7.00
1 fireman	3.00
2 pitmen, at $2	4.00
5 teams and drivers, at $5	25.00
Total labor cost	$43.50
Cost of excavation per square yard, $43.50/1400=	$0.03
Cost of excavation per cubic yard, $43.50/400=	0.11

between the curb and the car tracks, during each working day. The loading of teams was delayed on account of the frequent passage of cars. The labor per day for this work is given in Table 4.

In the fourth case a Thew revolving shovel equipped with a $\frac{3}{4}$-yd. dipper was used (in 1912) for the removal of a macadam surface on a section of a street in St. Louis. The street was 28 ft. wide between curbs and the macadam was from 13 to 18 in. thick. The total excavation was 2915 cu. yd. (loose measurement), the total operating time was 94 hr. or an average of 7.8 hr. per day for 12 days, and the average excavation was 31.9 cu. yd. per hour.

OUTPUT OF A SHOVEL

The writer was recently asked to give his opinion as to the output which may be expected from a standard make of revolving shovel and the depth of cut which is the minimum that this type of excavator can handle economically. It is clearly impossible to state any fixed rules for the determination of the output of a steam shovel or any other type of excavator. On any job there are always known but variable factors and often unknown and indefinite factors which cannot be accurately estimated until the completion of the work. Ordinarily a shovel will be in actual operation about 40 per cent of the working time. Some of the conditions affecting shovel operations are: Character and physical conditions of the soil; presence of obstructions in soil, such as boulders, roots, pipes, old foundations, etc.; depth and width of cut; size, make and capacity of shovel; experience and efficiency of operator. The log of efficient shovel operation under favorable conditions would be about as follows:

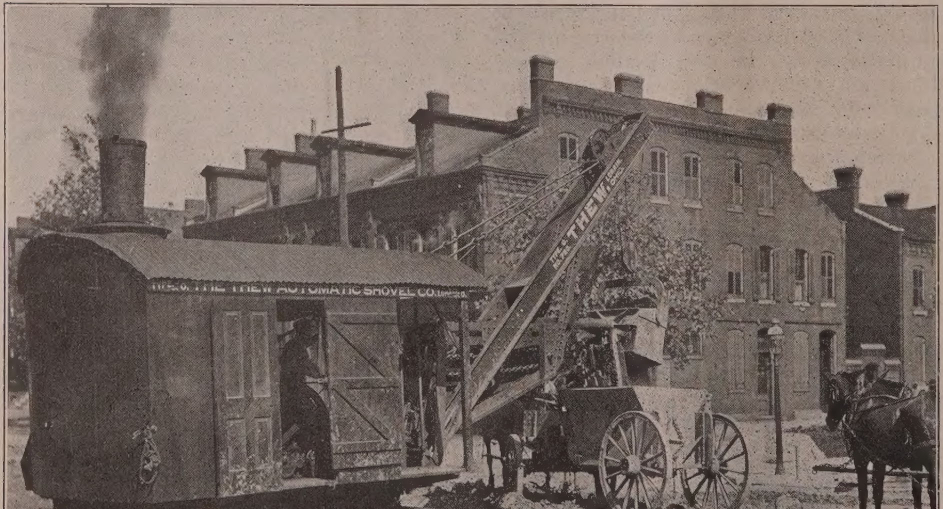
	Per Cent
Moving shovel	10
Waiting for cars or wagons	15
Repairs	15
Actual loading time	60
Total working time	100

In shallow excavations the percentage of time spent by the shovel in "moving up" would be greater than that stated, and would vary inversely as the cut. There would result a proportionate decrease in the actual loading time. Hence it is clear that it would be uneconomical to use a steam shovel when the total quantity of excavation is so small that the fixed charges of installation of the shovel on the job and its removal therefrom would bring the unit cost of operation above that obtained by the use of other methods and machinery.

TABLE 5—PERFORMANCES TO BE EXPECTED OF A REVOLVING STEAM SHOVEL IN SHALLOW EXCAVATIONS

	Classification of Material							
	Loose Earth		Packed Earth		Hardpan		Pavements	
Depth of Cut in Inches	Yardage	No. Observations	Yardage	No. Observations	Yardage	No. Observations	Yardage	No Observations
18	360	12	280	9	225	3	300	2
12	300	5	240	7	175	4	250	4
9	250	3	200	4	150	1	200	2
6	200	1	150	3	100	1	150	1

Although it is impossible to state any definite rules governing the capacity and limitations of a revolving steam shovel in shallow excavations, the data in Table 5, which have been compiled from various sources, may be suggestive. This table is based on the use of a revolving shovel equipped with a $\frac{5}{8}$-yd. dipper, efficiently operated under average working conditions for a ten-hour day.



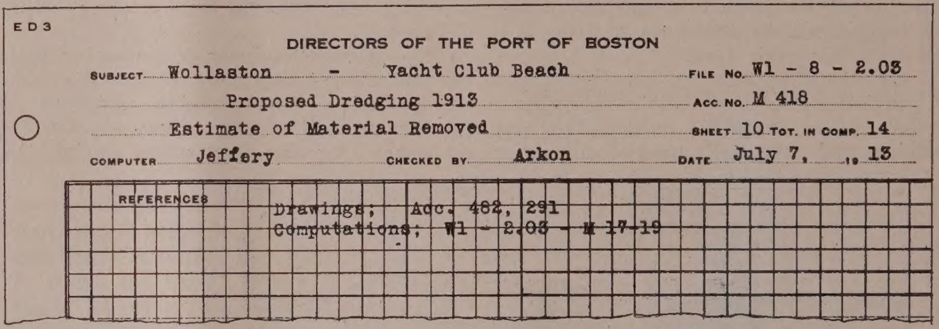
WHERE THE SURFACE IS HARD, THE STEAM SHOVEL PAYS ON VERY SHALLOW CUTS

Filing and Indexing of Office Computations

Discussion of Advantages of Bound Volumes and of Loose Sheets Filed in Binders and in Vertical Files

By FRANK H. JONES
Office Assistant, Directors of Port of Boston

THE FILING of computations presents, even in the well-regulated engineering office, more or less difficulty, depending on the nature of the work and the methods used by the computers in making calculations intended for record. Two distinct methods of making calculations intended for record are in vogue The first, and probably the most common, is by means of bound volumes in which computations are entered in sequence. These are dependent on their individual indexes as a guide to their contents. The manner of indexing the information contained in a large number of such volumes is generally vague and arbitrary, is often not attempted at all, owing to the amount of work involved, and is usually undertaken by persons not acquainted with the original intent and scope of the calculations.



ED3

DIRECTORS OF THE PORT OF BOSTON

SUBJECT Wollaston - Yacht Club Beach FILE No. W1 - 8 - 2.03
Proposed Dredging 1913 ACC. No. M 418
○ Estimate of Material Removed SHEET 10 TOT. IN COMP. 14
COMPUTER Jeffery CHECKED BY Arkon DATE July 7, 19 13

REFERENCES
Drawings; Acc. 482, 291
Computations; W1 - 2.03 - M 17-19

FORM SHEETS INSURE ORDERLY KEEPING OF COMPUTATIONS

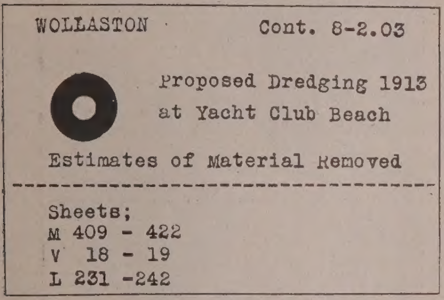
TWO METHODS USED

Such a series of books, if thoroughly indexed from the start and then indexed in a cumulative list, with periodic additions and corrections, serves faithfully the purpose of an accurate reference to a valuable collection of data. In the majority of cases, however, the individual computer is more than likely to neglect the proper indexing of his volume, and seldom takes either care or interest in reporting for the cumulative list valuable additions to his calculations. In consequence, half-indexed, poorly referenced volumes collect, which fail almost wholly in their attempt to furnish properly one of the most valuable adjuncts of a well-regulated engineering office.

The second method, now coming extensively into use, and acknowledged by all users as the most economical and the neatest, is that of loose-leaf calculation sheets and binders, with printed page headings for titling and referencing the computations, and periodic collection and filing of the sheets by those thoroughly familiar with the work contained therein.

MAKING THE CLASSIFICATION

Since card indexes are most universally used in referencing and indexing data, no mention need be made here of the older practice of index-book summaries of the contents of a file of data. The simplest and most reliable method of indexing or reindexing a set of calculation books containing individual indexes is to first prepare, with a thoughtful regard of all present and future considerations, an outline, or mold, into which all data on hand, or foreshadowed, may be cast. To prepare this may require either a suitable alphabetical guide, or a decimal system of notation, where all data are subdivided under integral main heads. Great care should be exercised in laying out such a system of integral numbers and decimal divisions that the considerations implied in the finished outline are not too minute; rather should they be too broad, for no amount of subdividing in the future, when necessary, would compare in work and uncertainty with too minute divisioning in the beginning.



WOLLASTON Cont. 8-2.03

Proposed Dredging 1913
at Yacht Club Beach

Estimates of Material Removed

Sheets;
M 409 - 422
V 18 - 19
L 231 -242

LINEN TAG FOR ATTACHING TO FILES

The form of indexing adopted makes little difference with the method of filing or "locating" the data. When the volumes are referenced by volume and page numbers the data may be most conveniently indexed by checking off each distinct and separate topic contained therein and "pouring" it into the index mold formed for it, great care being taken not to mistake the original intent or identity of the topic. Though these instructions are simple in text and, at the first reading, cover almost nothing but ordinary common sense, only those who have had experience in re-indexing or indexing an extensive collection of such data can appreciate the work involved in first laying out a suitable mold to include every conceivable form of data that may be encountered, nor will the average person, unused to files and indexing, appreciate the value of watching each item of data that passes through his hands. Endless complications result from the use of arbitrary considerations of this and that topic, ending in files which are of little or no value because based upon momentary points of view soon forgotten when no rigorous system is used.

FILING LOOSE SHEETS

The methods of locating, referencing and indexing the bound volumes of computations are quite simple in comparison with the various methods of filing loose sheets. One method of filing loose leaf sheets is to bind them permanently on collection and file them by the same methods that are used for the permanently bound volumes. This method is entirely practicable and is used extensively, often keeping each computer's sheets in a separate volume and referring to them by letter or by number, or both, as the conditions of future reference warrant. A second method, that of vertical filing, is a trifle more expensive and requires more room, but keeps the data of a specific topic or sub-topic together, and allows all future data in connection with that topic to be added without interfering in any manner with the matter already filed. This consideration is not essential under some conditions. For instance, in the case of a small engineering firm where data once used and filed are seldom, if ever, needed again, the bound volume method or loose sheets arranged in volumes is best.

The maximum degree of availability of data in reference to specific topics or subtopics is reached in the arrangement of computation files somewhat after the pattern of a correspondence file, but with more careful indexing and referencing.

To successfully put into use such a file, the outline of the topics, locations, alphabetical subjects, or whatever skeleton form is used must be complete and thorough. In the writer's experience, the decimal divisioning of integral numbers in connection with alphabetically arranged locations proved best suited to the requirements. To further facilitate the handling of file numbers and location of data each alphabetical location was given a letter, or letters, as for instance, B stood for Boston, and Wl for Wollaston. It should be borne in mind, however, that these letters are used simply to save the spelling out of the location on each sheet.

The decimal divisions and subdivisions are a matter of local consideration in filing practice, and no attempt will be made here to suggest outlines or methods of outlining such a system. In general, integral numbers for general topics and decimal divisions for sub-topics are used. For instance, the integral number 11 may stand for a power house, 11.1, 11.2, 11.21, 11.231, etc. Then represent the various considerations and sub-considerations that are met in the construction of such a plant. With the decimal outline well arranged, each general topic may be given its file location, divided and subdivided by means of tabs and folders into as many divisions, jobs, contracts and general considerations as may be necessary, and the computation sheets, when collected, sorted into topic considerations and filed in each corresponding location, division and subdivision.

USE OF FILE BACK

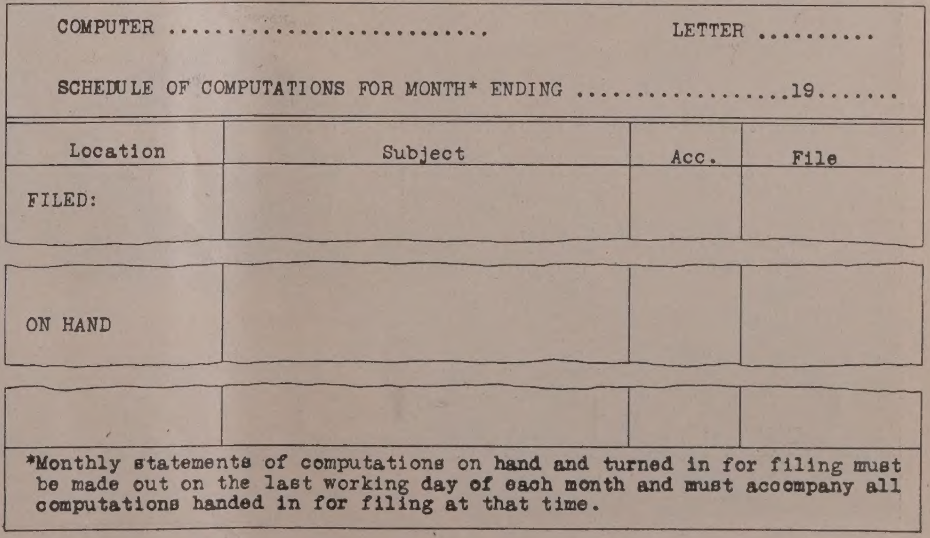
The method best adapted to this scheme of filing for preserving and arranging the loose sheets is by the use of the ordinary file back, or piece of cardboard, to which are attached by a brass fastener the sheets of data and a cloth tag on which are written the location, contract, job number, the file number or decimal division, the full title of the topic upon which the computations are based, and any other information of service in referencing. The location and file number should appear on each sheet, together with all other information in full that will, in the future, serve to identify the sheet. A standard form of printed heading for computation sheets should contain all information of value conveniently tabulated for instant reference.

This method has proved to be a simple and efficient means of carefully preserving valuable computations and compares quite favorably in cost with the more cumbersome volumes and card indexes. In the writer's experience a file of this sort may be used for almost any amount of data without a single index card, but in case the file becomes too large a simple card index may be introduced, laid out exactly as the files appear. This would require only a few days to copy the headings on a set of cards, and thereafter each addition could be entered in the card index.

PERIODIC FILING

The question of availability of individual computations at all times to those in charge of the work or to the entire office force engaged, perhaps, on the same general line of work, is one that offers peculiar difficulties in some instances, especially in large offices. It is noticeable that individual computers, interested only in the details of their own calculations pay little, if any, attention to the proper heading and complete referencing of their computations.

To insure, therefore, an accurate, periodic record of individual calculations in the possession of the computers and a means of determining how much matter is regularly filed and the condition in which it is turned in, a standard form headed, "Computation Schedule for the Month Ending....19....," may be used to great advantage. Its use requires no large amount of extra work either on the part of the computer or the file clerk. Under a heading "Filed," in the body of the form, the computer gives a classified list of all computations turned in for filing, thereby checking himself, automatically, on the proper referencing and heading of his computations and saving no end of trouble in the sorting and classification by clerks or others less familiar with the individual work. By the use of this system, accurate and up-to-date filing of all computations is assured.



COMPUTER .... LETTER ....

SCHEDULE OF COMPUTATIONS FOR MONTH* ENDING ....19.......

Location	Subject	Acc.	File
FILED:			
ON HAND			

*Monthly statements of computations on hand and turned in for filing must be made out on the last working day of each month and must accompany all computations handed in for filing at that time.

MONTHLY REPORTS SHOULD BE REQUIRED OF EVERY COMPUTER

Beat Scheduled Time Five Months in Building Huge De la Brea Sewer

How Los Angeles Built the Largest and Most Expensive Storm Drain in the West—Inspectors' Records Showing Rapidity with Which Work Was Carried Out

A RECORD in rapid sewer construction work was recently made when the $678,263 De la Brea sewer in Los Angeles, said to be the largest and most expensive storm drain in the West, was completed and ready for use more than five months ahead of the contract limit. One of the features of the work was the use of large reinforced concrete pipes with a capacity more than twice that of the Los Angeles aqueduct.

WHAT THE JOB INCLUDED

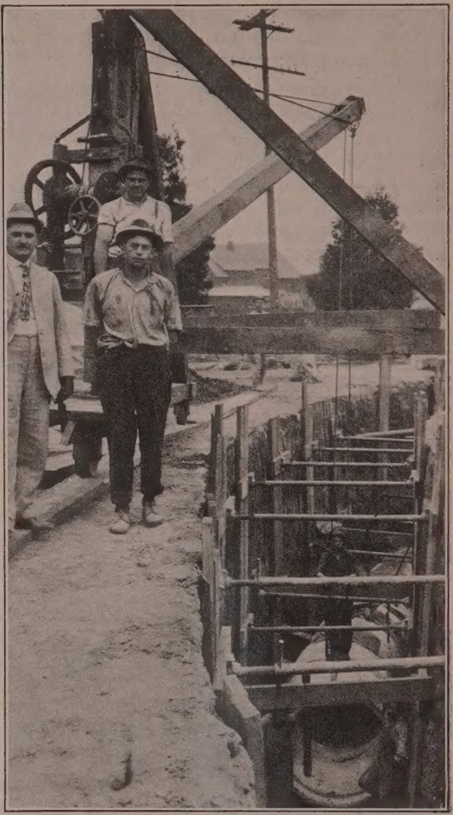
Work was begun April 30, 1914, on the 185,000 cu. yd. of excavation necessary in building the large drain and the entire job was finished in January, 1915. The main line of sewer is 7.7 miles long and there are 3.8 miles of laterals. The sources or heads of the new drain are at First and Alvarado Streets, Second and Colma Streets, Vendome and Council Streets and Bellevue and Coronado Streets, the last named being farthest north. The outlet is just beyond Third Avenue, near the Los Angeles Country Club. It empties there into a natural arroyo which, after many turns, empties into Ballona Creek. When the drain is filled to its capacity it discharges nearly 1000 cu. ft. per second.

The extent and diversified construction of the sewer can be seen from the following list of dimensions and lengths of the sections: Monolithic reinforced concrete, arch section 12 ft. 9 in. x 8 ft., 1240 ft.; 10 ft. x 8 ft. 4 in., 1621 ft.; monolithic concrete, rectangular section, 8 x 8 ft., 660 ft.; monolithic concrete, circular section, 8 ft. 6 in., 904 ft.; 8 ft. 3 in., 1225 ft.; 8 ft., 228 ft.; 6 ft., 804 ft.; 5 ft. 6 in., 2833 ft. reinforced-concrete pipe, 3-ft sections, 34 to 60 in. diameters, 26,790 ft.; brick, 1 ring, 23 to 36-in. diameters, 11,935 ft.; and vitrified pipe, 12 to 22 in., 9532 ft.

The appurtenances consisted of 8545 lin. ft. of vitrified pipe catch basin connections 12 to 16 in. in diameter, 357 catch basins, 137 manholes, 25 special junction chambers and one outlet structure. There were also five large wooden culverts to be uncovered and filled, existing catch basins to be connected, and modification made at paved intersections. In addition to the work mentioned the contract also called for the reconstruction of several sewers.

CONSTRUCTION PLANT

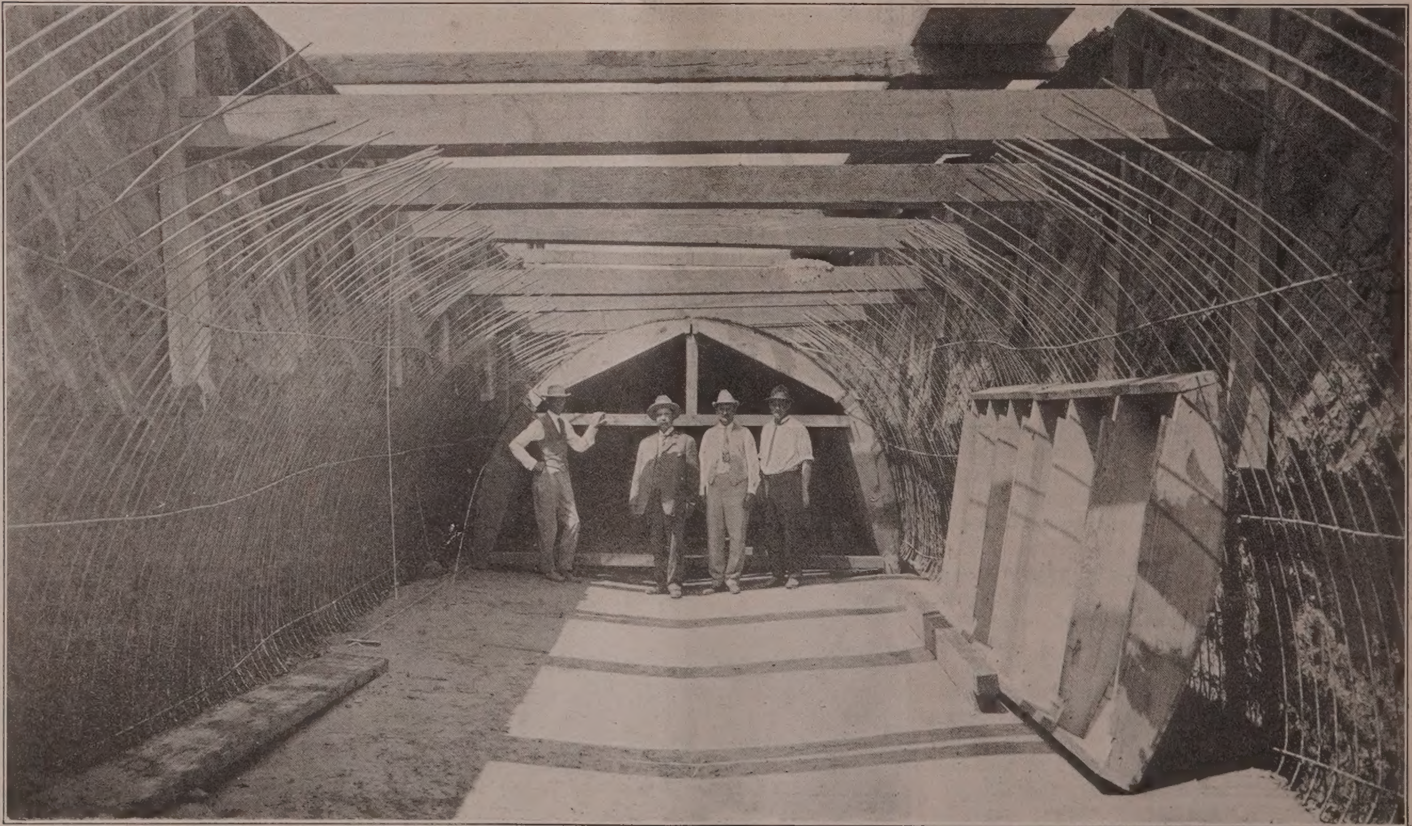
A Marion steam shovel, four oil-burning Parsons trenching machines, one Potter machine, and 500 men, were used in hurrying the large contract to completion. On sections up to and including 8-ft. widths the excavation was done by means of the Parsons trench machine with a capacity for 78 in. widths. The bottom of the trenches was shaped to receive the pipe. No concrete cradles were provided for, but gravel was frequently employed to give a stable subgrade.



THIS DERRICK PROVED VERY SUCCESSFUL IN LAYING PIPE

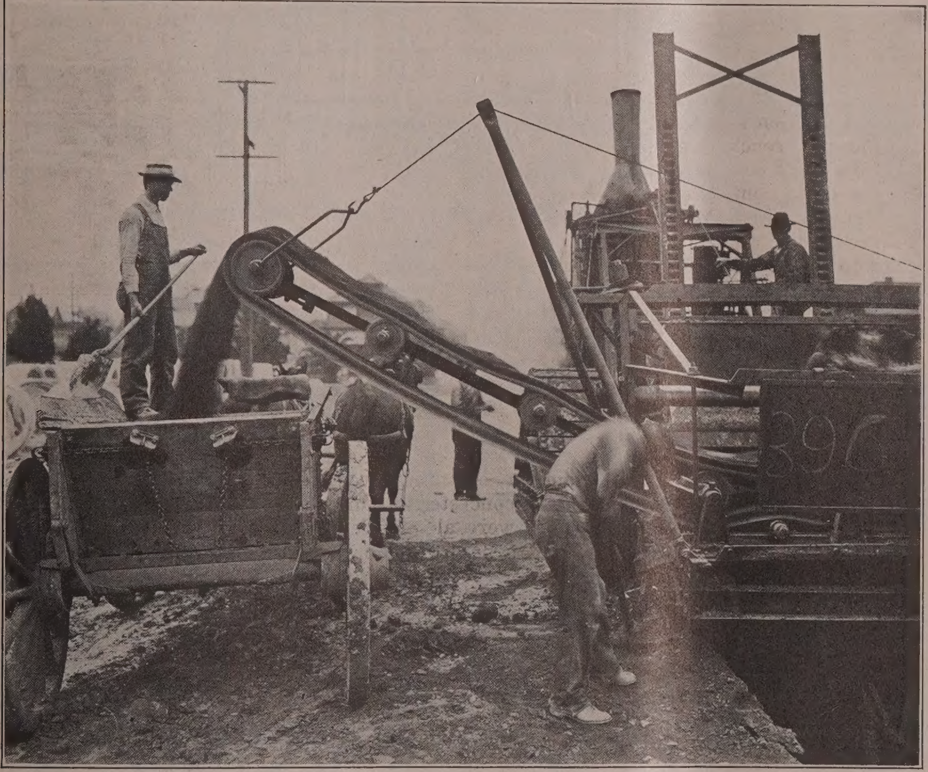
The Western Reinforced Concrete Pipe Company, sub-contractors, began molding pipe along the line of the sewer on April 14, 1914. Steel forms for all diameters made the pipe in 3-ft. sections. The concrete mixture was 1:2:4 and the pipes were allowed at least fifteen days to cure before they were handled. Pipe 60 in. in diameter, having a 6-in. shell and weighing 3600 lb. per 3-ft. section, was the largest size used, and the maximum depth of trench in which it was laid was 27 ft.

One of the photographs shows the style of derrick used to lower the pipe. T. A. Jordan, assistant engineer in charge of the construction for the city, had observed the



WITH AN AVERAGE DAILY CREW OF 7.3 MEN 598 FEET OF THIS INVERT WAS PLACED IN TEN DAYS performance of one of these machines working in the Los Angeles Harbor District and recommended them to the contractor. Due to an error in the patterns, the dogs in the brake mechanism worked improperly, and the hoisting line had to run under the drum, which caused the line to bind. The photograph shows how it cut into the idler. The device is believed by those who had charge of the job to be much superior to the chain block affair heretofore used in Los Angeles.

A grout of 1:2 proportions was specified for closing joints. The operation consisted in placing shields of heavy roofing paper or sheet iron, 7 to 8 in. wide, on each side and tamping them tightly against the shield with sand or soft dirt. Grout was then poured from the top of trench through a chute into the joint on one side of the pipe until it made its appearance part way up the opposite side, when the pouring was continued in the latter side. This method was pursued to insure the continuity of the mortar joint. If the grout did not flow around, the joint was dug out and the trouble corrected.



TRENCH EXCAVATOR AT WORK, LOADING SURPLUS DIRT DIRECT INTO WAGON

RANDOM EXTRACTS FROM THE RECORD

The following examples of progress in pipe laying are taken at random from inspectors' daily reports. In a trench about 10 ft. deep, a crew of 10 men working 14 days, of 9 hours, laid 745 ft. of 54-in. and 193 ft. of 60-in. pipe, or an average of 67 ft. per day, the maximum day showing 116 ft. and the minimum 36 ft. laid.

In another trench 6½ ft. in width, 11½ to 18 ft. in depth in wet caving ground where a 6-in. subdrain was laid and gravel was used in the bottom to a depth of 10 in., 622 ft. of 54 in. diameter was placed in 13 days with a crew of 10 working 9 hours, an average of 48 ft. per day, 0.87 of a sack being the average amount of cement required for joints. Toward the latter part of the work 234 lin. ft. of 48-in. and 1326 ft. of 42-in. pipe were laid in 12 days, an average of 130 ft. per day, with a crew of 8.3 men. The trench was from 4 to 7 ft. in depth, and being in an isolated section was free from the interferences usually encountered when working in city streets. The average amount of cement per joint was 0.28 of a sack.

TRIMMED TRENCH MEANS FAST WORK

The secret of the fast pipe laying, says T. A. Jordan, assistant engineer, Los Angeles, was in keeping the trench carefully trimmed to templet, well in advance of the laying crew, and watching such details as having a hook or clevis that could be detached quickly from the pipe saddle, when timbers or jacks interfere.

The quantity of mortar needed for the joints varied noticeably at times, and depended upon the care used in placing and tamping the shields. This difficulty was avoided in pipe having the open joint inside for the lower half.

HOW THE EXCAVATION WAS HANDLED

The excavation was started April 30, 1914, on Tenth Street at Hobart Boulevard, with a Parsons excavator and a Potter trench machine. Surplus dirt was loaded in wagons direct from the excavator while the trench machine backfilled the completed sewer with the balance. Most of the backfilling, except that with the Potter machine, was done by teams and Mormon scrapers and wagons. On one stretch of deep ditch an engine and drum were rigged to drag the Mormon. Waste dirt was disposed of in ditches or otherwise low lying ground. At one point several hundred feet of 3 x 3-ft. wood drain and 12 x 16-in. vitrified pipe was laid in the old arroyo in order that it might be filled before the sewer became operative.

With scrapers and wagons 3060 cu. yd. were backfilled in a length of 765 ft. of trench 16 ft. wide in 13 days, with an average crew of 1½ men and 2 teams, drivers included. The trenches were all flooded, a fire hose with nozzle was shoved into the backfilling at close intervals until the latter was saturated.

RECORDS OF CONCRETE WORK

Records kept on the progress of concreting the monolithic sections show that 368 ft. of 5 ft. 6 in. diameter circular section, no reinforcement, were placed in 5 days with a crew of 15 men, an average daily yardage of 42.2 cu. yd., using 53 bbl. of cement. The depth of trench was 13 ft., and conditions were favorable. Further along in the same trench, at a depth of 17 ft., through an alley where very bad filled ground and two large residences close to the excavation complicated matters, the same crew concreted 442 ft. in 10 days, a daily average of 25.3 cu. yd., using 32 bbl. of cement. Placing and removal of forms were included in each of the above records. The comparison illustrates the influence of varying trench conditions on the progress of concreting, other factors being the same.

A record of a section of the arched type 13 ft. 4 in. x 8 ft. 4 in., shown in the accompanying photograph, is given herewith. The method pursued was first to concrete the invert and place the reinforcing. Templets were set to grade and a long, heavy straight edge was used to form the concrete after tamping; the steel rods previously bent were set and held to position by notched templets while their lower ends were imbedded. Of this invert 598 lin. ft. were placed in 10 days with an average daily crew of 7.3 men, equal to 24 cu. yd. each day, using 29.8 bbl. of cement.

For the arch 577 ft. were completed in the same period of time with a crew of 11.6 men, or approximately 62 cu. yd. per day, using 76.7 bbl. of cement. The quantities of cement given are actual counts.

Reinforcement was placed for 578 lin. ft. by an average daily crew of 5.2 men, working 10 days, and a corresponding number of feet of forms were erected by a crew of the same daily average in the same number of days. Five hundred and sixty feet of forms were removed by crew of 2.2 men for a 10-day period, of 9 hours a day. The number of men building forms changed from time to time as occasion demanded, but as a general rule 1100 sq. ft. complete, including oiling, using roughly 2500 ft. of lumber, could be turned out in 9 hours by a force of 3 carpenters and an equal number of laborers.

HOW PAVEMENT WAS CUT

Pavement was cut out with pick and sledge and with an Ingersoll-Rand rotary drill, operating with steam from the excavating machine. A drill bit was first tried, but proved unsatisfactory. A pick pointed tool was then substituted, and the rotation removed. The results were then quite acceptable. However, the comparison submitted herewith by Mr. Jordan, seems to favor the former method. Three thousand seven hundred and ninety-eight square feet of 3-in. asphalt, on a 5-in. concrete base, was cut out in 10 days, with an average crew of 2.7 men using pick and sledges, and with a drill 4750 sq. ft. was removed in the same time with average crew of 5 men. It is not believed that the quality of the concrete differed enough to affect the results. For rapidity in cutting holes in concrete and vitrified pipe, a sharp pick, where it could be handled, was found to work to best advantage. It was much superior to a hammer and chisel.

Difficulties Encountered

The excavation was required to pass a templet of the outside dimension of the sewer to line and grade with the result that trenches were frequently larger in places than necessary, particularly back of the steam shovel, aggravated at times by caving. This condition increased the daily consumption of concrete in several instances as much as 12 cu. yd. and for days at a time exceeded the requirements, but the contractor preferred to lose it rather than delay and fuss with back forms. The loss of empty cement bags through theft and use for protection reached the somewhat startling figure of nearly 20,000.

Weather conditions were very favorable until the latter part of the work, when several hard rains retarded the completion about two weeks and increased the cost to the contractor very appreciably.

Land Owners Assessed

The district that was assessed to pay for the improvement included in round numbers 10,000 parcels of land. It was divided into a general district and four zones, the rate per square foot for each was derived from the following considerations: A 50 per cent higher rate than that of the general district was assumed for zones 2 and 4 because, due to the topography, the maximum benefits from the drain would accrue to them. Zone 1, located near the upper end of the district, was allowed a credit of $21,894, the estimated cost of extending the sewer later in connection with certain street paving. Zone 3 was given a credit of $3,036, the estimated value of the existing drains that were continued as part of the new system.

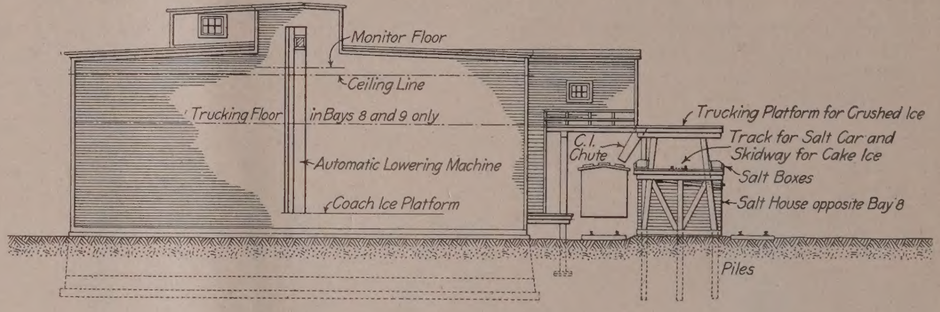
James Kennedy, Los Angeles, the contractor, was represented on the job by John P. Kennedy, manager, and J. R. Graham, engineer. For the city, Homer Hamlin, city engineer, was represented by A. C. Hansen, chief deputy, E. A. Tuttle, engineer of storm drain design, and T. A. Jordan in charge of construction. The Engineering Record is indebted to Messrs. Hamlin and Jordan for many of the figures quoted.

A Colorado Gravel Road well placed and properly maintained will last for two or three years without any renewals, according to J. E. Maloney, State highway engineer. New gravel must then be added in worn spots.

40,000-Ton Railroad Icehouse Electrically Operated

Modern Icing Facilities Provided by Michigan Central Railroad in Connection with Expansion of West Detroit Yards

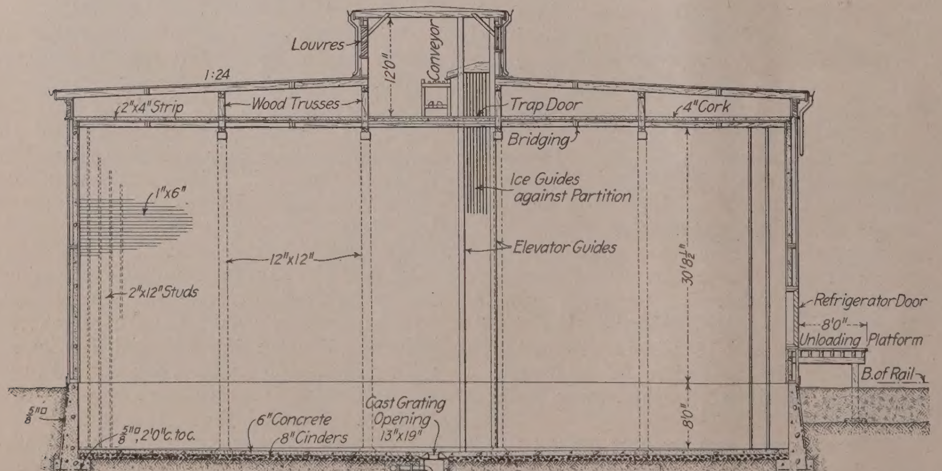
An icehouse electrically operated, with a capacity of 40,000 tons, is a feature of the West Detroit yard expansion of the Michigan Central Railroad at Detroit. The house, which is a frame structure 87 x 580 ft. in plan, is made up of fifteen sections or rooms, each of which has elevator facilities for loading and unloading ice. The layout is arranged so that either cake or crushed ice can be delivered as desired. Provision is made for icing refrigerator and fruit cars at the same time. A salt house is located at the east end of the icing side of the house.


Monitor Floor
Ceiling Line
Trucking Floor
in Bays 8 and 9 only
Automatic Lowering Machine
Coach Ice Platform
C.I. Chute
Trucking Platform for Crushed Ice
Track for Salt Car and Skidway for Cake Ice
Salt Boxes
Salt House opposite Bay 8
Piles

EAST ELEVATION OF DETROIT ICEHOUSE SHOWS LOADING SYSTEM

The entire structure has below ground 8 ft. of its total icing height of 38.7 ft. The side wall of the building which rests on a reinforced-concrete foundation wall 10 ft. 8 in. high is made up so as to have a 6-in. layer of cork against the inside sheathing of the house and a 6-in. air space between the outside of the sheathing. Outside the outer sheathing is a layer of Keystone insulator and then a drop siding. The sill is anchored to the concrete foundation wall by a 7/8-in. bolt 18 in. long. The ceiling of the ice rooms is upheld by four intermediate 12 x 12-in. posts, as well as by the side walls. This ceiling is made up of a 4-in. layer of cork resting on a 1 x 6-in. sheathing. The roof and monitor rest on wooden trusses which in turn rest on 12 x 12-in. posts.

The floor consists of a 6-in. layer of concrete resting on 8 in. of cinders; it has a pitch of 2 in. from the side walls to a 2½ x 2½-ft. concrete catchbasin located in the center of the building, a distance of 40 ft.



40,000-TON ICEHOUSE IS 87 FEET WIDE AND 580 FEET LONG

Ice is loaded from the crusher on a trucking floor which is built between sections 8 and 9, opposite and in line with which, on the outside of the building, there is a trucking platform for crushed ice. Beneath and at the east end of the trucking platform is a salt house, with a truck for salt car, salt boxes and skidway for cake ice on top. The coach ice platform is located at the east end of the building.

Putting a Cake of Ice Through

In filling the ice house, ice is received on an unloading platform on the north side of the house and pushed through one of the fifteen refrigerator doors to an inclosed elevator, whose front is made in removable sections 4 ft. long. The elevator is then raised or lowered according to the height of ice in the room, the front sections are removed and the ice contents of the elevator are slid off into the room. The house is filled to within 2 or 3 ft. of the top.

When ice is to be taken from the house it is run on an elevator located in the center of the room, which carries it up to the monitor floor, whence it is automatically deposited on a conveyor which in turn feeds its icy burden to a crusher. The crushed ice is delivered, by gravity, to the trucking floor, on which ice carts of 1000 lb. capacity are located. Ice from the carts is then sent through a cast-iron spout to the waiting refrigerator cars. In obtaining cake ice the conveyor carries the chunks of ice to the east end of the house, where it is brought to the coach ice platform by an automatic lowering machine. The elevators have been arranged so that those used in filling the house cannot be operated when the inside lifts are in use. In this way the elevators can be operated by four motors instead of eight, which would otherwise be necessary. Also there is no necessity for using outside elevators when the inside ones are in use. Four Allis-Chalmers 440-volt motors, each operating four friction hoists, are used in connection with the elevators.

With the above facilities, 400 cars can be iced per day, the maximum to date being 200, and the average 100.

The building was designed and erected by the W. E. Wood Company of Detroit, under the direction of G. H. Webb, chief engineer of the Michigan Central Railroad, and J. F. Deimling, formerly engineer of construction and now assistant chief engineer.

Flagpoles and American Flags are supplied to all stations and buildings of the San Diego water department. Flags are displayed daily. For public information station designations and directions have been posted throughout the $8,000,000 system, which extends over nearly 100 miles.

Aggregate for This Job Is Mechanically Handled from Pit to Road

Storage in Elevated Bins at Main Plant and at Job—Efficient Operation Demanded Design of Special Mixer

EXCAVATED, screened, washed, dumped into railroad cars, carried to storage bins, dropped into industrial cars in proportional parts for a mixer batch, dumped from the industrial cars directly into the mixer skip, and finally spouted onto the subgrade as concrete, the sand and gravel for 11½ miles of 18-ft. concrete road on the Lincoln Highway, between South Bend and New Carlisle, Ind., is mechanically handled from beginning to end.

The aggregates are purchased by the contractor from the Geo. J. Hoffman Company, South Bend. The company's pit was originally opened about 7 years ago by the Chicago, Lake Shore & South Bend Railway, an electric line, for ballasting their track. New machinery was installed and the pit reopened this year by the Hoffman company.

OPERATIONS AT THE PIT

A 1-yd. Bucyrus steam-shovel excavates the material, dumping it into hopper-bottom cars running on a standard-gage track. These cars are then hauled by a 20-ton Davenport locomotive up a small incline to a trestle over a hopper and dumped. From this point a belt conveys the material to a revolving screen, which separates the boulders, of which there are a large number ranging up to a foot or more in diameter, the gravel falling into a bin. The boulders are run through a gyratory crusher and the broken pieces passed through the screen.

From this bin, which has a hopper bottom, the gravel is conveyed by another belt up to the washing plant, as shown in the accompanying photograph. This plant has two conical revolving screens of the Gilbert type and washes and separates the gravel into three grades, the finest material being a pure sand. The lower portion of the plant, as seen in the photograph, consists of the three large bins into which the material is delivered and stored. From these bins the gravel and sand for the concrete road are loaded by chutes into the cars of the Chicago, Lake Shore & South Bend Railway, each of which holds about 30 cu. yd. of material. The railway tracks parallel the road under construction for the entire distance, which has rendered delivery an easy matter.

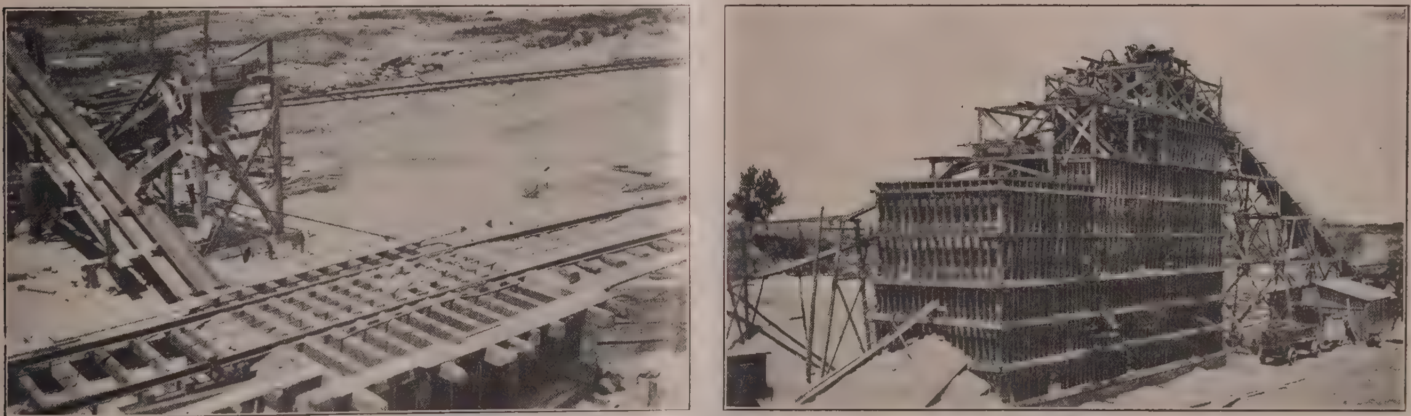
HOW AGGREGATE IS HANDLED ON THE JOB

Three miles from New Carlisle a siding was put in and the contractor's gravel and sand bins and cement sheds erected. The railway at this point is on a fill, and so in putting in the siding a hopper was built under the track opposite the center of the bins. From this hopper both gravel and sand are raised by a small bucket conveyor to their proper bins. The bins are of equal size and hold about 35 yd. each. This is rather small but, as there is another electric line close by, the space was limited and it was impossible to build them larger. With unlimited space a capacity of about 75 yd. would have been used.

Chutes in the bottom of these bins discharge the sand and gravel directly into the Koppel cars, which run on the 2 ft.-gage industrial track built on the other side of the bins. Beginning at the sand bin each industrial car is loaded with 9 cu. ft. of sand, the amount being measured by a templet fitting into the car. Passing on to the gravel bin, 15 cu. ft. of gravel is added and last of all six bags of cement are piled on top from the cement sheds. Fifteen cars make up a train—a third of the total number—so at all times one set is being loaded, another unloaded at the mixer, and the third in transit.

The mixer is a special one built for the contractor by the Marsh Capron Company. One of the special features is the design of the skip, which is at right angles with the axis of the drum on the side of the mixer, so that when lowered the side-dumping industrial cars discharge their contents directly into it. By this means all rehandling of materials at the mixer is done away with, a much smaller crew is required and there are no wagons or wheelbarrows to cut into the subgrade. No material is lost by being trampled into the ground or getting mixed up with the earth subgrade. Moreover, there is little danger of cement getting wet in a sudden storm, and no cement pile for a leaky hose to play on.

The contractor feels, also, that there is less danger of having some batches of con-



PIT MATERIAL IS DUMPED FROM CARS INTO THIS HOPPER AND ELEVATED TO SCREENS AND BINS

MATERIAL CARS, LOADED FROM ELEVATED BINS AND CEMENT SHEDS, DISCHARGE DIRECTLY INTO ELEVATOR OF THIS SPECIAL MIXER crete with improper proportions, as it is so much easier to fill the industrial cars with the proper amount of material than to count the number of wheelbarrows being dumped into the skip and to see that each is filled properly.

MISCELLANEOUS

Aside from the handling of materials there is little in the operation of this work different from other good-sized concrete-road jobs. In grading a Thew steam shovel with a $\frac{5}{8}$-yd. dipper is used on some of the cuts, which range from 10 to 12 ft. in depth. As many as thirty-five teams have been employed on this part of the work. Part of the contractors' new equipment consists of steel side-forms, which are of the ordinary channel type. Joints are spaced 30 ft. apart and protected with steel plates. The mixer is equipped with a 15-ft. chute.

The concreting record so far is 450 lin. ft. in one day of ten hours. One train of fifteen cars has been unloaded and the concrete mixed and placed in 30 min. Water is obtained by pumping from wells. For that part of the work now in progress four wells were driven, about 2 miles from the New Carlisle end of the work, on the right-of-way alongside the grade. The pump is run by a 6-hp. engine using kerosene as fuel. It is figured that this will supply 18,000 gal. per day through fairly level country for a distance of about $2\frac{1}{2}$ miles. A pressure tank insures a steady pressure of about 30 lb. per square inch. The 2-in. pipe line is provided with T's 150 ft. apart to furnish connections for 1-in. hose running to the mixer and for sprinkling the concrete. In addition there are cut-out valves about 700 ft. apart.

Plans and specifications for the road were drawn up by Henderson McClellan, county engineer of St. Joseph County, Indiana. J. M. Rush is deputy engineer on the job. The contractors are Jacob Akerman & Company, Laporte, Ind., with whom is associated F. Runyon of Valparaiso, Ind. The work was let at \$174,675—an average of about \$15,000 per mile of road. The width is 18 ft., the thickness 6 in. at the sides and 9 in. at the center. The concrete was mixed in proportions of $1:1\frac{1}{2}:2\frac{1}{2}$.

THE REVENUE FROM THE WATER-SUPPLY SYSTEM in Los Angeles, Cal., was \$54,713.43 for the first week in June. This is the first time the weekly income from this source has exceeded \$50,000.

Water Motors Operate Gate-Valves in Nozzle Lines

Compact Design, Mounted on Valve Yoke—Nozzles Themselves Equipped with Ring Deflectors

By J. W. SWAREN
Hayward, California

IN a new double over-hung tangential unit which is being installed by the Alaska Gastineau Company at its Salmon Power House, one of the most interesting features is the use of two 20-in. motor-operated gate-valves in the nozzle lines between the terminal "Y" and the needle nozzles. These gates are operated by a water motor of standard Pelton design, with double-face instead of single-face buckets, these permitting economical operation with either direction of rotation. Referring to the accompanying view, the method of mounting this water motor on the stand of the rising-stem gate is plainly shown; also the gearing arrangement for driving the gate spindle.

OPERATION

The water for operating the motor is taken from a bonnet and a valve and two needle nozzles are provided on each motor, one for either direction of rotation. These nozzles are marked *C*.

The cycle of operation is as follows: Assuming the valve to be closed, if it is desired to open it, the needle valve *C* is opened; the motor, through the gearing, opens the valve. At *B* is shown a tappet on the stem of the valve. When the valve is fully open, this tappet strikes a tappet arm, the mechanism of which is shown at *A*, Fig. 1. This operates a deflector, which deflects the stream of water from the buckets and thus prevents over-running. When the valve is fully open, the operator closes the needle valve *C*.

When it is desired to close the valve, the needle valve on the opposite side is opened, whereupon the motor drives down the gate spindle until the tappet *B* strikes a corresponding tappet arm on the other side of the yoke, thus preventing over-running at closure.

Assuming the valve to be wide open and the operator by mistake to open the needle valve *C*, the tappet would be holding the deflector in such a position that no water would strike the buckets, thus preventing any possibility of damage to the mechanism.

Referring to Fig. 2, the general arrangement of the water motor is plainly shown. At *D* is shown the mechanism for operating the equalizing by-pass valve, so that the operator can easily equalize the pressure on both sides of the gate before attempting to open it.

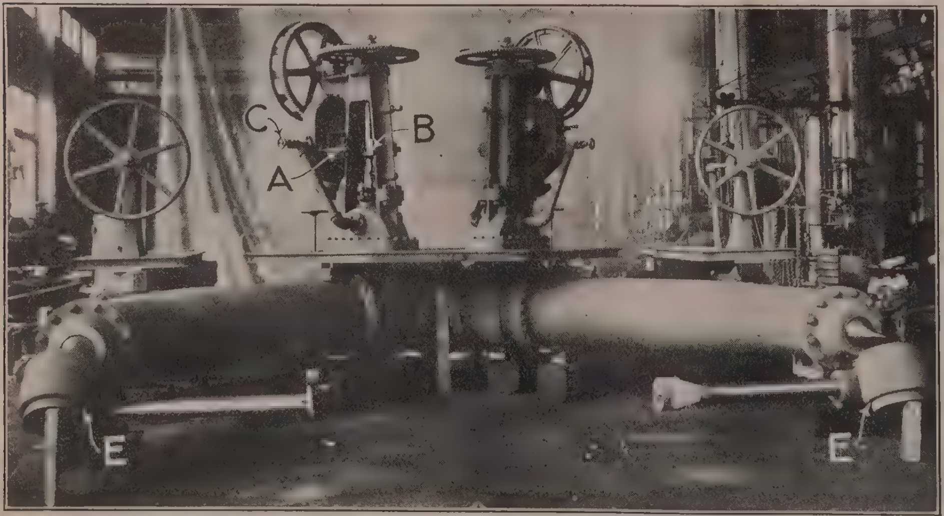


FIG. 1—GATE-VALVES ARE OPERATED BY WATER MOTORS MOUNTED ON VALVE YOKES

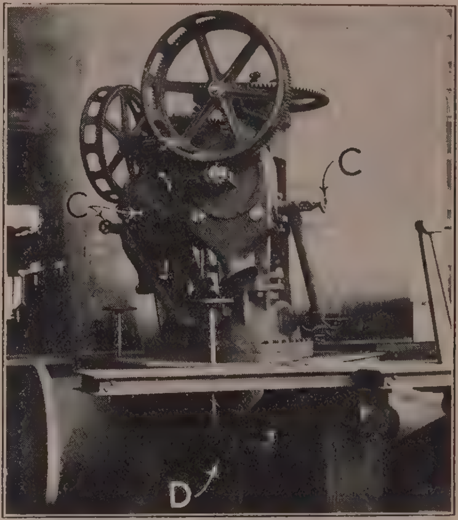


FIG. 2—CLOSE VIEW OF MOTOR

At *E*, Fig. 1, is shown the deflectors which will be used for governing. These are of the ring type, a new development along this line, the advantages of this type being a material quenching of the energy of a jet when it is deflected.

The needles and the needle nozzle are hand operated by the usual needle mechanism.

The entire unit is designed to operate under 390-ft. head and develops 2500 hp. The photographs were taken on the erecting floor of the manufacturer prior to shipment.

Illinois Central Railroad Reduces Grades in Kentucky

THE PICTURE on the front cover of this issue is taken at the Iron Hill cut of the Illinois Central Railroad in Kentucky, between Princeton and Paducah. By reducing the ruling gradient from 1.25 per cent to 0.50 per cent against southbound traffic (0.75 per cent being allowed against the lighter northbound traffic) the company has doubled its tonnage capacity per train. The cut shown was the largest on the improvement, which has just been completed; 630,000 cu. yd. were involved in the cuts. The work was done under the direction of F. C. Walter, Jr., assistant engineer, who reported to F. L. Thompson, assistant chief engineer.

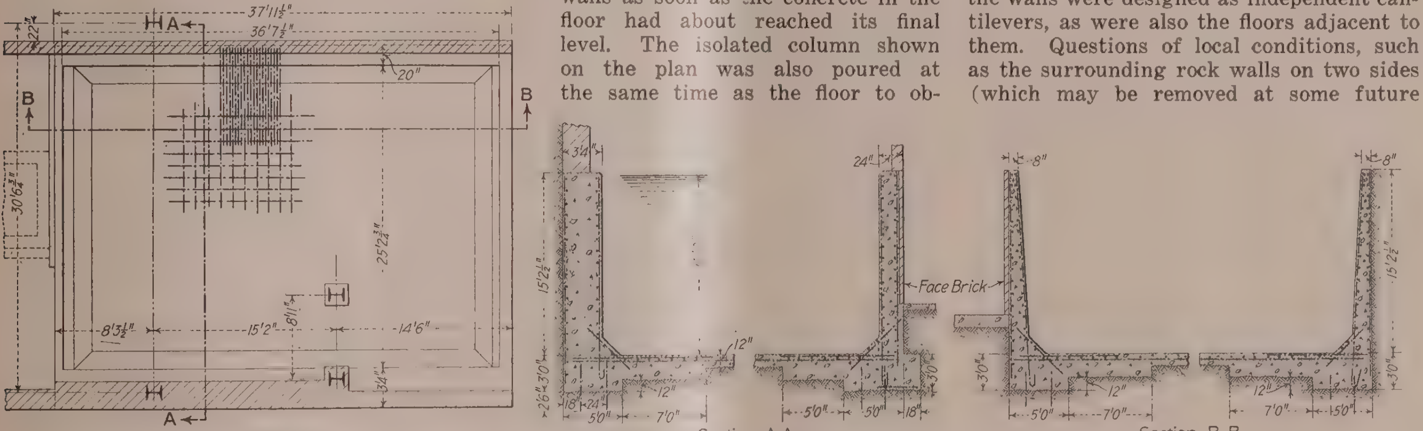
THE TOTAL PRODUCTION OF EXPLOSIVES in the United States during the year 1914, exclusive of exports, according to figures compiled by Albert H. Fay of the U. S. Bureau of Mines, was 450,251,489 lb. or 225,126 short tons, as compared with 500,015,845 lb. or 250,008 short tons for 1913. The production for 1914 is segregated as follows: Black powder, 206,099,700 lb.; "high" explosives other than permissible explosives, 218,453,971 lb.; and permissible explosives, 25,697,818 lb. The figures represent a decrease of 23,839,831 lb. of black powder; 23,932,573 lb. of high explosives; and 1,987,952 lb. of permissible explosives, as compared with 1913.

Reinforced-Concrete Tank of 100,000-Gallon Capacity Designed by Use of Diagrams

Forms Constructed to Insure Continuous Pouring of Concrete—Waterproofing and Dense Concrete Employed to Prevent Leakage

By A. R. JAMES
Bing & Bing Construction Company, Inc., New York City

IN THE ARTICLE entitled "Rapid Construction of Additions to Steel Building," by H. E. Mitler, which appeared in the Engineering Record of March 27, page 404, reference is made to the erection of a reinforced-concrete tank in the basement of this building, which furnishes the water supply for the operation of the sprinkler system. This type of storage reservoir is adaptable in the construction of loft buildings where there is need of a large supply of water, and where steel tanks would be undesirable owing to difficulties that would be encountered in their construction. The general dimensions and typical sections of the tank are shown in the accompanying figure. The location was in the basement below the arch of a mezzanine floor, which formed a cover for it, and which contained a manhole for entering the tank to inspect and clean it when necessary.



Plan

Section A-A

Section B-B

GENERAL DETAILS OF REINFORCED-CONCRETE TANK FURNISHING WATER SUPPLY FOR SPRINKLER SYSTEM

ANCHOR RODS AND FORMS

After the excavation was completed to solid rock, holes were drilled for 1-in. anchor rods, which were then placed and grouted in, and the entire floor of the tank was covered with 2 in. of concrete in order that the rock would be preserved during the process of form erection and fabrication of steel, all of which had to be done within the limits of the tank.

Forms for the inside face of the tank were constructed of 1-in. tongue-and-groove yellow-pine boards, which were nailed horizontally to 2 x 4-in. uprights spaced about 2 ft. on centers, and which were hung from the steel floorbeams above. To these uprights 4 x 6-in. timbers were spiked, running horizontally about 5 ft. apart. In order not to have any braces or other timbers resting on top of the floor, and in order to pour floor and wall in one operation, a central hip was constructed, also hung from the steel beams above, and from this hip 3 x 10-in. struts were run at 6 ft. intervals to the 4 x 6-in. horizontals on all of the forms. This system of bracing made it necessary to pour all four walls at the same time.

The concrete was machine mixed, using one part of a tested Portland cement to two parts of selected washed sand and four parts of clean, well-graded gravel, the intention being to obtain as nearly watertight concrete as possible by a proper grading of the aggregate, although it was thought wise to use a waterproofing compound as an additional precaution against any possible leakage.

The concrete, beginning with the floor, was poured continuously to the tops of the walls, the chutes being switched to the walls as soon as the concrete in the floor had about reached its final level. The isolated column shown on the plan was also poured at the same time as the floor to obtain a perfect bond at its base. The total amount of concrete, 250 cu. yd., was poured in about forty-two consecutive hours, the men working in ten-hour shifts.

The vertical bars in the walls were hung by wires fastened to 2 x 4-in. timbers placed on top of the steel floorbeams above the tank. The horizontal $\frac{1}{2}$-in. bars were then clipped to the vertical bars with patented clips. This arrangement permitted the shorter vertical bars to be clipped to the horizontal $\frac{1}{2}$-in. bars at the various heights and spacing required by the design.

In waterproofing the concrete it was decided to use the Trus-Con waterproofing paste, which was stirred into the water at the mixer. Two barrels were used, one for mixing the water and paste, and the other for the mixed product which was placed adjacent to the mixer. Where the 16-in. discharge pipe passed through the concrete wall the joint was sealed by packing with oakum soaked in a very viscid plaster bond. Cement was then troweled over the oakum, and both pipe and concrete adjacent to the hole were covered with two coats of hot tar. This seems to have made a tight joint, as there has been no indication of leakage in six months, although there is vibration of the pipe whenever the pumps are working.

DIAGRAM FOR CANTILEVER WALLS

In the design of this reservoir, the diagram on page 136 was used. The required thickness of any reinforced-concrete wall subjected to hydrostatic pressure with a head not exceeding 24 ft., and the required amount and spacing of steel in a section 12 in. wide at any height of wall for a given head of water can be obtained from this diagram.

The thickness of wall derived from the curves in this chart are minimum values only, and depend, as is shown more clearly by the formulas given later, upon shearing and bending-moment considerations. These thicknesses may be increased and the amount of steel reduced if thereby an economical result is obtained and the space occupied by the tank or retaining wall is not a determining factor. The effect of the steel used in the outer, or compression, side of the walls has been neglected.

Slab action in the upright cantilevers is neglected entirely in this design and also in the chart, as the reductions in stresses which would result may be made by the designer for any individual case, and because this action is almost entirely eliminated in a wall of any length. In the present case the walls were designed as independent cantilevers, as were also the floors adjacent to them. Questions of local conditions, such as the surrounding rock walls on two sides (which may be removed at some future date), a brick curtain wall carried by the concrete wall forming one side, incased steel columns and all other items whose consideration would tend to reduce the stresses as actually obtained, were all finally discarded and the strength of the structure figured for maximum conditions only. Should this type of reservoir be constructed on a clay or gravel bed, additional investigation would also have to be made at the base for proper distribution of the soil pressure.

Considering the typical section *BB* of the tank shown in the figure, at the top of the wall the thickness of 8 in. was adopted as a practicable minimum, including a 2-in. protective covering to the main steel, the bars being placed at a depth of 6 in. from the outside face of the wall.

THEORY AND USE OF DIAGRAM

The diagram contains three sets of curves: A bending-moment curve from which data are obtained for calculating any values of A_s desired; a set of lines for obtaining the required thickness of wall at base for any head of water h, or thickness of wall d' at any depth of wall h' sustaining a total head of water h; and finally, a set of curves which give the required area of steel A_s, for a length of 1 ft. of wall at any depth h' for a total head of water h. The thickness d of the upright cantilever at the top is assumed in all cases as 6 in., and the base thickness is determined either by the compressive fiber stress in the concrete for heads less than $17\frac{1}{2}$ ft., or for greater heads (up to 24 ft.) by the shearing value of concrete. Reservoir walls whose heights

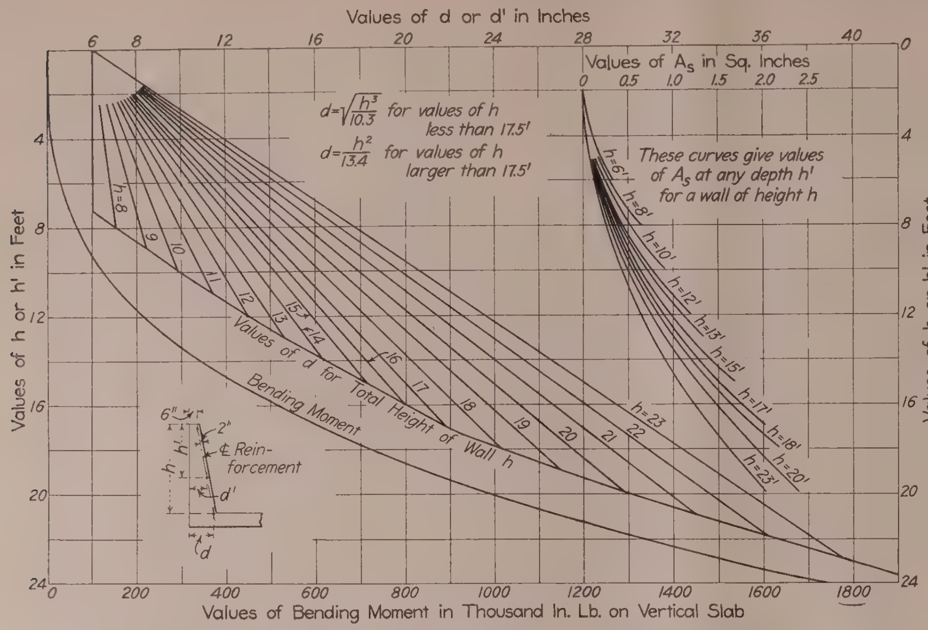


DIAGRAM FOR DESIGNING WALLS UNDER HYDROSTATIC PRESSURE

are greater than 24 ft. are usually more economical if designed with counterforts.

Having found the required thickness d at base of wall from the d curve, any intermediate thickness d' at any depth h' is obtained at once from the lines having their apex at $d = 6$ in. Equations from which the data for plotting these curves were obtained are given below, using standard notation. Let $f_c = 650$, $f_s = 16{,}000$, $v = 40$, $b = 12$ in., $k = 107.4$. Since $M = kbd^2 = wh^3/6$, w being taken at 62.4 lb. per cubic foot,

$$d = \sqrt{\frac{M}{107.4 \times 12}} = \sqrt{\frac{h^3}{10.3}} \qquad (1)$$

Total shear $V = P = vbjd = wh^2/2$ for hydrostatic pressure.

Assuming $j = 7/8$, and solving for d,

$$d = h^2/13.4 \qquad (2)$$

Equating these values of d and solving for h, $\sqrt{h^3/10.3} = h^2/13.4$ and $h = 17.5$ ft., or for a head of water of 17.5 ft. the thickness of wall is the same for both shear and bending-moment considerations. For values of h less than 17.5 ft. equation (1) governs, and for greater heads than 17.5 ft. equation (2) must be used. From these two values of d the d line is plotted, and at points on this curve corresponding to the different heights of wall lines are drawn to a point representing a 6-in. effective wall thickness.

The required area of steel in the bottom of the wall at any height for a 1-ft. length of wall is given on the A_s curves, which were plotted from the formula

$$A_s = \frac{8\,M}{16{,}000 \times 7d}$$

taking d directly from the d curve and M from the bending-moment curve. These curves give values of A_s at any point of a wall whose total height is shown on the A_s curve. To obtain depths at which, say, half this amount of steel and hence twice the spacing of bars is required, find the point on the A_s curve corresponding to half the area of steel required at the base, and on the right-hand margin find the depth at which the required spacing is to be made. Any other spacing may be found in a similar manner. Bars should extend beyond this point the distance of fifty diameters required for bond consideration.

Horizontal steel was assumed sufficient at 1-ft. centers, and was also placed, in conjunction with vertical bars of the same size and spacing on the outside faces of the walls around the entire tank to take up the shrinkage caused by temperature changes. In the floor of the tank the shrinkage bars were laid both ways 1 ft. on centers, and since the location of the tank prohibits the use of a toe at the bottom, the stresses in the top of the floor caused by the overturning moment were partly taken up by these bars, and the remaining stresses by special bars, placed as shown in the figure. The horizontal shrinkage bars were carried around the corners to some distance along adjacent walls, to prevent cracking at the corners.

It is possible that the thickness of the wall might be altered for certain conditions, as was the case in the present construction, where, for instance, a curtain wall 2 ft. 4 in. wide rested on top of one side of the tank, necessitating a thickness of $d = 3$ ft. 2 in., a value greatly in excess of that required for the head of water impounded.

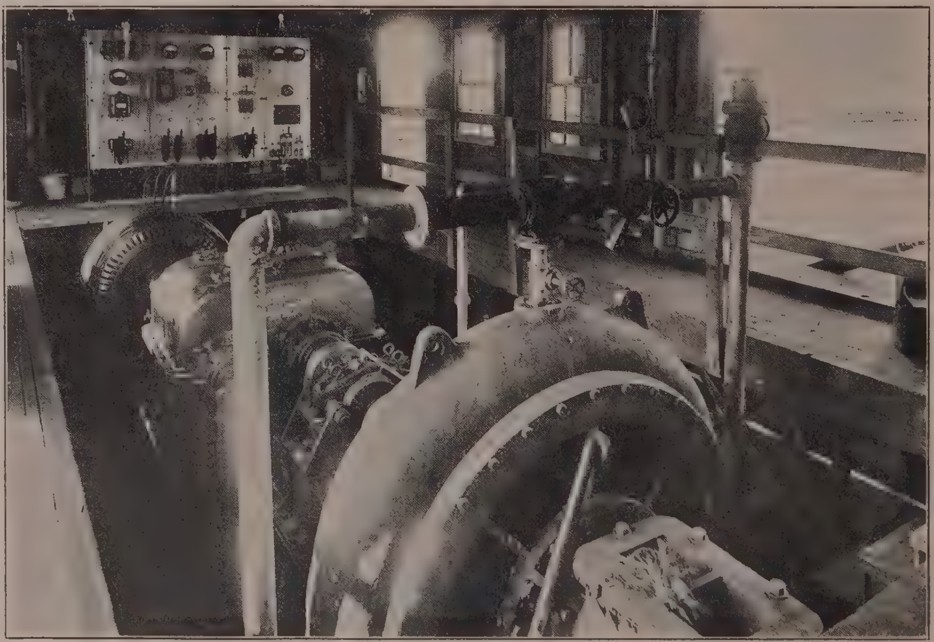
The tank was designed by the writer, and constructed under his supervision by the Bing & Bing Construction Company, Inc., of New York City, general contractors. The design was checked by Weiskopf & Burroughs, also of New York City, consulting engineers for the architect, I. E. Ditmars.

Minneapolis Dredging Pump Operates Electrically

Two-Speed Reduction Gears Give Low Power Consumption and Maintenance Cost in Driving 15-Inch Pump on Hydraulic Dredge

A SPEED REDUCTION from 720 to 300 and 250 r.p.m. between the motor and the main 15-in. dredging pump is effected by helical gears in a dredge designed in 1914 for improvement work on Lake Nokomis for the city of Minneapolis. The entire plant on this dredge consumed less than ¾ kilowatt-hour per cubic yard dredged in service. It was designed by the Norbom Engineering Company of Philadelphia, to the secretary of which, George S. Hoell, the Engineering Record is indebted for a summary of the features of the dredge, and the considerations governing its design.

The convenience and cleanness of electric drive for various types of machinery has for some time made it desirable to operate hydraulic dredges electrically. This motive power has been applied without difficulty to the auxiliary machinery. The cutter head, for instance, running at from 10 to 20 r.p.m., is operated through reduction gears and shafting with considerable flexibility. Even a sudden stop can be taken care of by a blowout switch. On the other hand, while electrically driven centrifugal pumps have been used successfully for many years, the electrically driven dredging pump presents features that must be given earnest study if the dredge is to be a success. A small and fast rotating runner such as is necessary with a direct-connected motor is very inefficient and soon wears out. Even



LARGE DREDGE PUMP DRIVEN AT LOW SPEEDS BY HIGH-SPEED MOTOR

Reduction and change of speeds accomplished by cut helical gears—pump running, shown by blurred shaft coupling; vibration slight, as indicated by sharpness of photograph.

the speed of an extremely slow motor, 350 r.p.m., is a high speed for dredging pumps, and furthermore such a motor is undesirable on account of its high cost, bulk and low efficiency. A one-speed motor, whether of high or low speed, is too rigid to be desirable for a dredge that one day has to pump against a 5-ft. lift and 200 ft. of pipe and the next against a 25-ft. lift with 2000 ft. of pipe line. If the motor and pump have been designed for effective work for the latter condition, they will be practically useless on the former. If the speed of the motor is varied by resistance in the circuit through a controller, the waste of power is very great. A multiple-speed motor is also undesirable, on account of its intricate construction and wiring, and its high cost.

LARGE RUNNER SELECTED

For the dredge at Minneapolis, then, a large pump runner, 54 in. in diameter, was selected to insure an efficient working length of the vanes. It is given flexibility by having two speeds, one 250 and the other 300 r.p.m. The pump is driven by a 500-hp. synchronous motor running at 720 r.p.m. The speed reduction and speed change are effected through two sets of cut helical gear running in an inclosed casing and lubricated with oil. A lever on top of the gear box, connected with a rigid clutch, locks the gears in position for the desired speed.

The combination of the synchronous motor and a pump of ample and efficient size, equipped with this speed-change device, furnishes an economical unit for dredging purposes. The loss of efficiency in transmission through the reduction gears is less than 2 per cent, and actual results with a pipe-line length varying from 500 to 2000 ft. over a period of two months have shown a power consumption of from ½ to ¾ kilowatt-hour per cubic yard of excavation. This figure includes all the power used on the boat, both for the auxiliary machinery and for the main pump.

The low speed is used with pipe lines up to 1200 or 1500 ft. in pumping against a 12-ft. head, and the high speed for any resistance greater than this. The cutter head is operated by a 50-hp. slip-ring motor, and the main hoisting engine by a 30-hp. motor of the same type. This hoist has five drums and two winch heads. A water-jet exhauster operated by an auxiliary pump is used for priming the main pump. There are also provisions for fire service, water sealing of the stuffing box on the pump and of the ball joint on the ladders, and for pumping out the bilges.

Three-phase 60-cycle current at 2300 volts is used without transformation for the three principal motors. This current is transformed to a lower voltage for the service motor, and a motor-generator set is installed for furnishing direct current for lighting. A 6000-candlepower searchlight, several arc and incandescent lights, and an electric horn for signal purposes are inserted on the direct-current circuit. The whole plant is installed on a hull 80 ft. long, 24 ft. wide and 7 ft. deep, which draws 40 in. of water.

The dredge under average conditions has excavated 5600 cu. yd. per day, place measurement. The maximum 24-hr. output so far recorded is more than 7000 cu. yd. The Northern Dredge & Dock Company is contractor for the improvement work on which the dredge is being used.

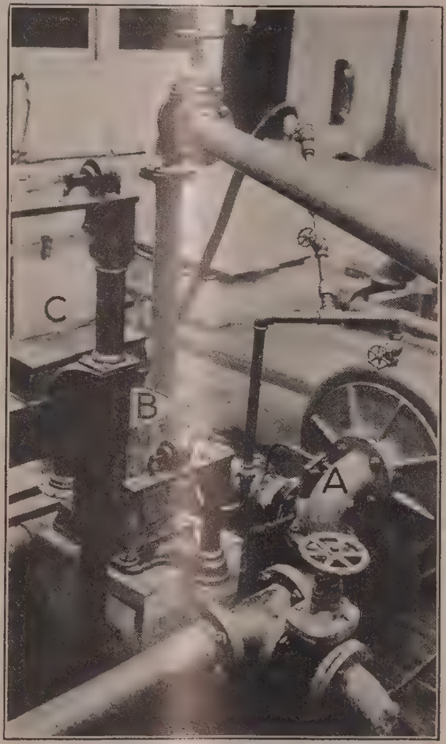
Salt Solution Method Used for Testing Centrifugal Pump

Accuracy Shown to Be Within 1.15 Per Cent, Even Without Refinements Hitherto Used for Turbine Tests

By BEN D. MOSES
Berkeley, California

THE recent suggestions as to methods of measurement of stream, turbine and pump discharges by the use of chemicals call for quite thorough verification. Two independent runs have been made on a small 3½-in. centrifugal pump, used for circulating purposes in the hydraulic laboratory at the University of California.

The pump took its suction from a 20 x 20 x 12-ft. concrete tank and discharged through a 3½-in. line, 40 ft. long, into a concrete weir box. From the box the water ran over a 30-in. weir into a spillway and could be deflected by a special scooping device into a 7 x 7 x 12-ft. rectangular concrete tank. This tank was fitted with a hook gage, graduated to millimeters, and had been carefully calibrated previously by means of a weighing tank. The actual measurement then was accurate to within at least 1 per cent.



PUMP TESTED BY SALT-SOLUTION METHOD

In the first run a 25 per cent salt solution was used, it being introduced into the suction by means of a ¼-in. pipe tapped into the side of the elbow at *A* (see figure). This led, by means of a rubber tube, to a 5-gal. oil can, *B*, placed on a platform scale.

After the pump had been started and was running steadily a sample of the discharge was taken, then the salt solution admitted, after its weight had been carefully taken, and the time of flow obtained with a stop watch. During the run samples were gotten of the discharge, readings taken of the hook gage on the tank and time recorded.

The second run was a little more elaborate, there having been added another solution tank and a pair of scales, *C*, fitted with a float and pulley arrangement to insure a constant level in the tank directly connected to the pump. Samples were also taken right at the discharge, only some 14 in. from the "dosing" tap.

The data in the table show the general results and the possibilities of the method in connection with such tests.

It would seem from the above results that the greatest sources of error would be encountered in (1) the uniform introduction of the solution into the suction and (2) in the mixing of the dosing solution and the water.

It is to be hoped that the laboratories equipped with the means will run exhaustive tests, trying out different methods of dosing, sampling, etc. If, however, the method can be relied upon to within 1 or 1.5 per cent, as the first two tests indicate, its use is advisable over that of any other device. Even in the third case the error was less than 3 per cent. This error, while comparatively high, is really remarkably low in view of the fact that the salt solution had to mix in about one-fifth of a second and before it had moved 2 ft. It was injected at the wall of the elbow and removed at the wall of the discharge. Without doubt under the proper conditions of injection and sampling an accuracy of 1 per cent could be hoped for.

The above data seem to point out the following:

(1) The dosing and sampling stations should be as far apart as possible, say 100 times the diameter of the pipe.

(2) The dosing must be effected under a constant pressure, insuring a constant rate.

(3) A dosing and a sampling pipe that extended across the suction and discharge respectively and contained side perforations would assist in the mixing.

(4) A saturated solution of salt contains about 25 per cent, so that possibly a 20 per cent solution would in general be the safest, or about 2 lb. of salt per gallon of water.

DATA ON PUMP TESTS, USING SALT SOLUTION

	Test 1	Test 2	Test 3
	Using one solution tank	Using two solution tanks	
		(Sample 40 ft. from discharge)	(Sample at discharge)
Weight of solution in tanks before run, lb	57.1	73.20	73.20
Weight in tanks after run, lb	26.3	33.00	33.00
Amount injected, lb	30.8	40.20	40.20
Time of injections, min	4	5	5
Rate of dosing, lb. per sec	0.1283	0.134	0.134
Specific gravity	1.192	1.115	1.115
Q = Rate of dosing, cu. ft. per sec	0.00172	0.001921	0.001921
Comparative strength as obtained by filtration with $AgNO_3$ *solution*			
Supply water	0.968	1.55	1.55
Discharge water	8.88	10.19	10.015
Salt solution	5036	5510	5510
R = ratio salt strength to increase in water strength	636.5	639	651
Quantity discharged = R x Q, sec. ft	1.094	1.229	1.25
Quantity by measuring tank, sec. ft	1.099	1.215	1.215
Error	0.005	0.014	0.035
Error, per cent	0.46	1.15	2.88

(5) A rate of dosing of about 1 gal. of salt solution to 500 gal. discharge seems ample. This would mean on a 100,000-gal. pump 200 gal. of salt.

(6) The salt solution injected would better be weighed than measured volumetrically.

(7) A sensitive hydrometer, calibrated to thousandths, might be used for obtaining the specific gravity of the salt solution.

(8) The titration method is convenient and simple, there being only a call for comparative and not absolute strengths of the different samples, so that they may be rated in terms of the amount of titrating solution ($AgNO_3$) required for equal volumes.

In Test 1 the exact amount of salt in each sample was actually worked out, but in 2 and 3 all comparisons were made upon the amount of titrating solution needed.

In closing it may be stated that the whole scheme is clean, accurate, simple and scientific, and would appear to be applicable to all types of centrifugal-pump or turbine tests.

ROAD-DRAGGING is compulsory in Kansas, but the township highway commissioners are not allowed to expend more than $15 per mile per year for any one mile. The amount paid by law is not to exceed $1 per mile for each time dragged, provided the width to be dragged is not less than 16 ft. and if not less than 30 ft. the amount paid is limited to $1.50 per mile for each time dragged.

Stations for Third Track, New York Elevated, Placed Above Existing Platforms

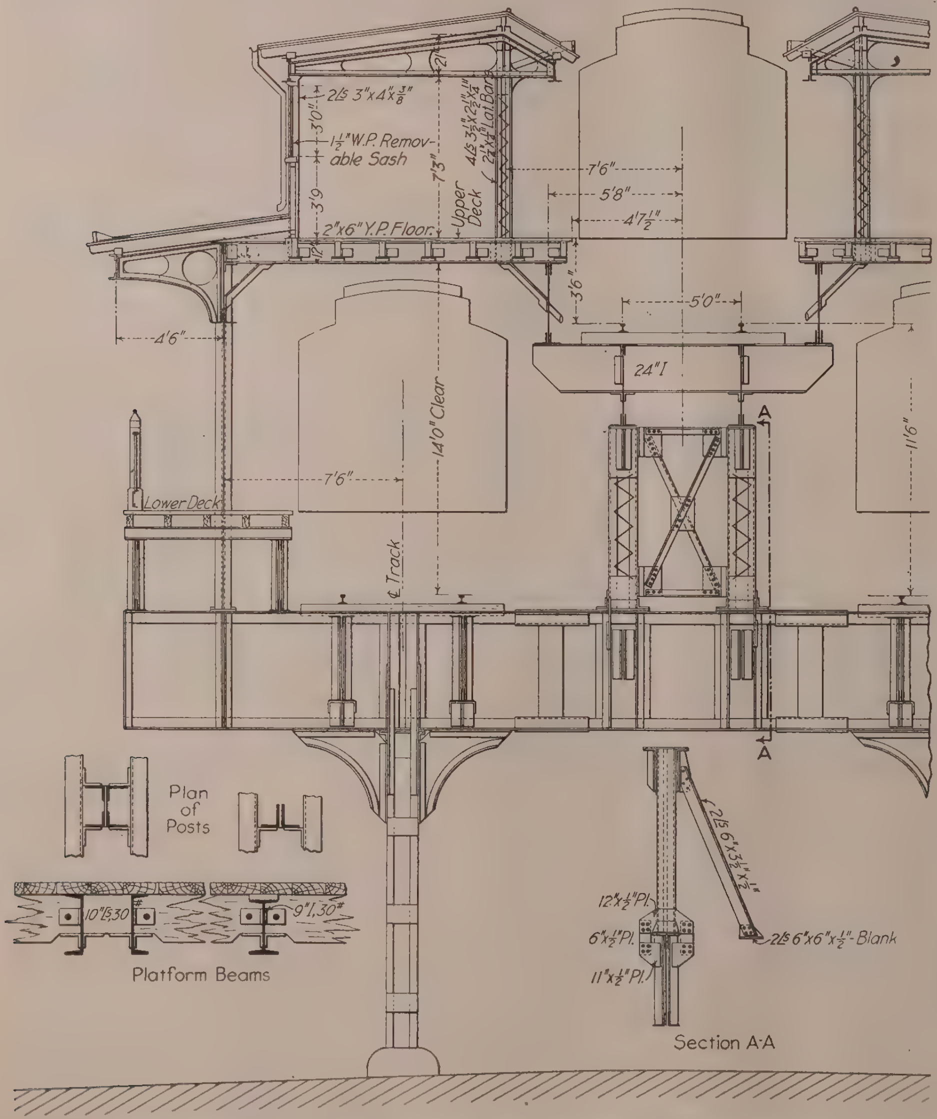
New Track Raised 11½ Feet Above Old Level Instead of Widening Structure—Special Provision Necessary for Bracing Bents Only 5 Feet Wide

SUPPLEMENTING the explanation in the Engineering Record of June 19, page 781, of some problems in the design of the third-tracking of the New York elevated railway, there will be described here some of the details in the hump construction at stations. For this purpose the Third Avenue line will be used. This construction is typical of the hump type adopted for the new express stations at Fourteenth and Eighty-sixth Streets, on the Second Avenue line, at Fourteenth, Thirty-fourth, Sixty-sixth and 145th Streets, on the Ninth Avenue line, as well as at Ninth, Twenty-third, Forty-second and 106th Streets on the Third Avenue line. An example of rapid erection on this work was given in the Engineering Record of Jan. 16, page 86.

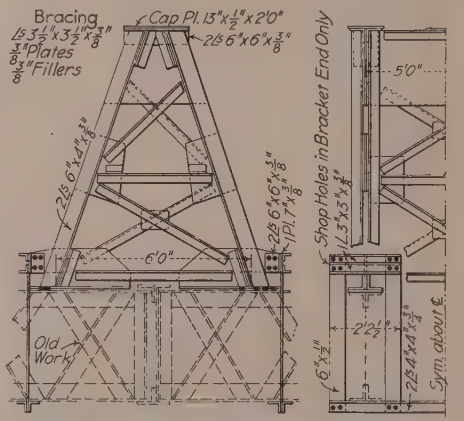
The general scheme adopted was to use hump construction supported by bents on the new cross girders, utilizing old stringers when possible. The maximum grade of 3 per cent, the 350-ft. express stations and the grade of the existing double-track line fixed the length of the hump. When the old line is level, it requires about sixteen panels to rise the necessary 11½ ft., allowing for the vertical curves at each end. If the existing track grades also form a hump, the length is increased; if the old track grades form a depression, the length is decreased. It is anticipated that the cost of operation of the express trains will be greatly decreased due to saving in braking when entering these stations and the rapid acceleration when leaving them. The special features include the tie plates connecting the higher bents with the cross girders, the new diagonal struts, with connections between the new bents and old track stringers, and the special bents carried by two adjacent panels at the Forty-second Street station.

New Construction Required

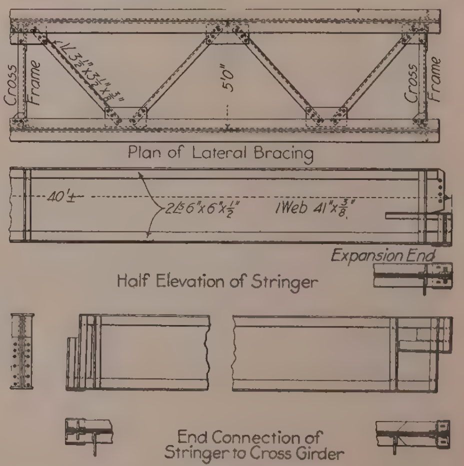
On the Third Avenue line the old double-track elevated construction, which had been partially reinforced, contained many panels of third-track stringers between the outside tracks, usually provided to allow the installation of cross-overs. Except below the upper platforms at the new express stations, where new columns and new cross girders were provided to carry the added platform loading, the old columns were reinforced to carry the third tracks. New cross girders were required at all other bents where no third-track stringers were already provided. The old center-track stringers were used, when available, in all cases where



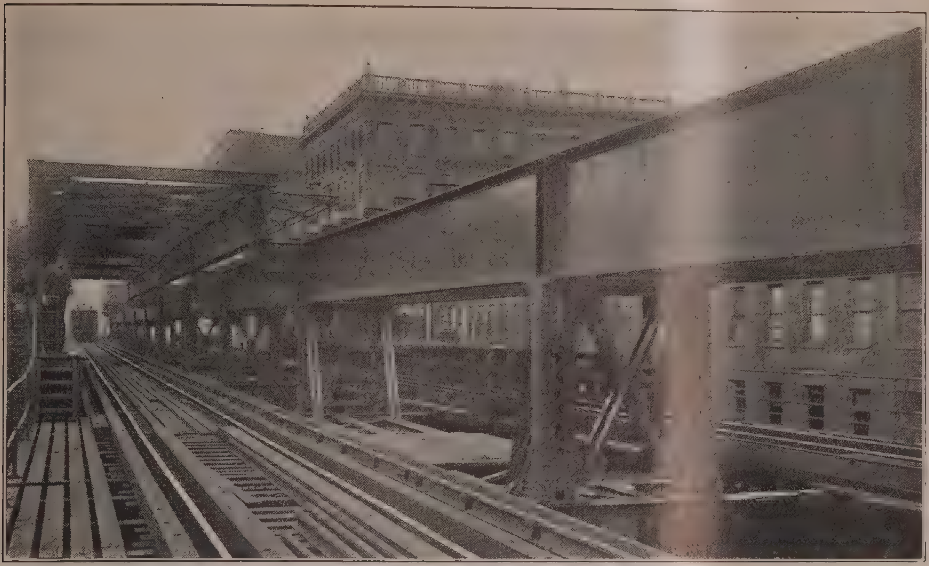
CROSS-SECTION AT TYPICAL STATION FOR THIRD-TRACK EXPRESS SERVICE



DETAILS OF SPECIAL TOWER SUPPORT AT FORTY-SECOND STREET STATION



END DETAILS OF STRINGERS



BENTS WITH DIAGONAL BRACES SUPPORT NEW TRACK STRINGERS AND PLATFORMS

the tracks remained at the same level. When the third track had to be elevated to reach the upper-level express station, new plate-girder stringers, which varied in end details from panel to panel to connect to the cross girders, were used. The old stringers could not be utilized because of difficulties in cutting them out without injury.

When the stringers were several feet above the cross girders, small bents braced by a diagonal strut to the old track stringers, when such stringers had been provided, were used. The old stringers were retained in every other bay, except in special cases, as at the Forty-second Street station. If no old stringers were available, new latticed struts between the cross girders were used for the alternate panels and diagonal struts from the top of the bents connected to the first upper-panel gusset plates. The accompanying photographs and drawings indicate the method of connecting the new bents and struts, and show the details of the tie plates used for the higher bents. Wind pressure on empty cars was sufficient to require this tension connection, the bents being only 5 ft. wide in order to use struts to the old stringers which had the same spacing.

DETAILS OF STATION CONSTRUCTION

In order to keep the new upper-level platforms as low as possible, only 12 in. was allowed for the platform beams and floor. The fixed height of 3 ft. 6 in. from platform to rail and the required overhead clearance of 14 ft. resulted in the rise of 11 ft. 6 in. required at all typical stations. The details of the steelwork at these express stations are shown on the drawing. The 24-in. I-beams over the bents support the inside longitudinal platform stringers, while the outside stringers are connected to the new columns carried by the main cross girders. Brackets from these columns support the canopy roof for the protection of the lower platform.

All the timber construction and details are of the standard type, as suggested by the general cross-section. Copper gutters and 3 x 4-in. leaders carried down beside the columns are used. Well constructed timber wind shields, with removable glass window sash, are provided outside the upper platforms. The general appearance of the station framing is shown by one of the photographs.

One of the detail drawings gives some of the end details of the new longitudinal stringers, the top lateral bracing and the position of cross frames. Where the 24-in. I-beams pass across the bents, the main webs of the stringers had to be blocked out at the ends as shown. It should be noted that all stringers are 5 ft. apart or directly under the rails, and, therefore, all columns of the bents are spaced only 5 ft. apart, hence the relatively small resistance to overturning due to wind or to centrifugal force on curves. The tension plates and their connections by plates to the cross-girder stiffeners and wing-plates on the columns of the bents are shown on the main section.

At the Forty-second Street station, on some bents of the north approach, the old track stringers in adjacent panels support the special form of bent shown in the accompanying drawing, in which the old latticed track stringers are shown by dash lines, and the bent with 6-ft. bottom spread straddles the old cross girders. This form of bent was adopted because of the difficulty at these cross girders in making provision for attaching columns. The slope to provide for grade is furnished by the beveled plates on the top of the bents at the ends of the stringers. Slotted holes are provided for the expansion stringers, as shown. At the 106th Street station there are two spans about 66 ft. long. In this case the old track stringers were replaced by deep triangular trusses, supported by the cross girders and carrying the level track on the upper chord.

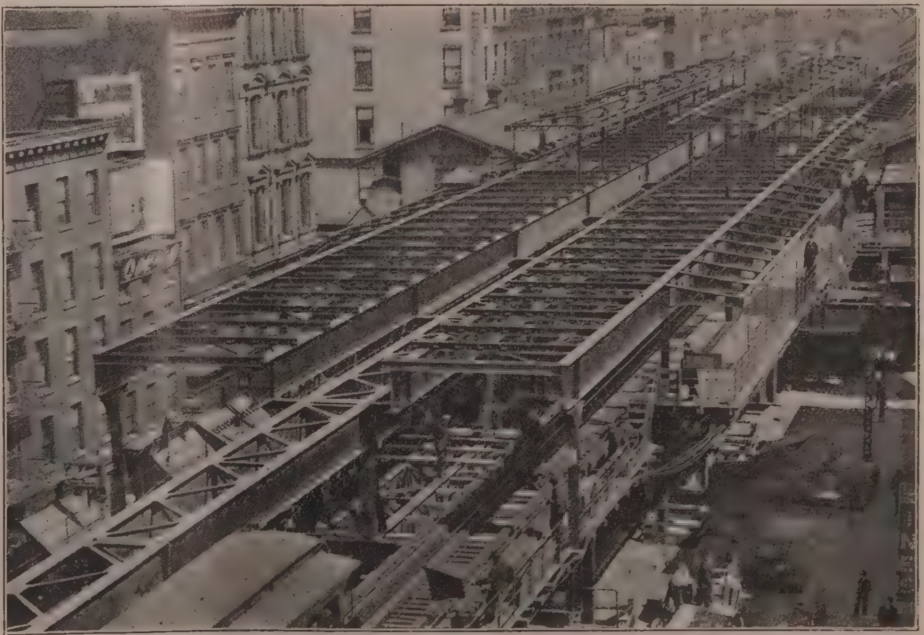
The design loads and stresses for this work were given in the article of June 19. The design and details have been prepared under the direction of George H. Pegram, chief engineer, F. W. Gardiner, principal assistant engineer, and S. Johannesson, assistant engineer, of the Interborough Rapid Transit Company. The contractors are the T. A. Gillespie Company, executives, Terry & Tench and Snare & Triest.

Compressed Air Cleans Concrete Road Base Before Oiling

ON certain parts of the California highway system now under construction it has been found that before the surfacing oil could be applied sufficient dust had formed on the concrete base to interfere with the proper bonding of the oil. After some experimenting a compressed-air apparatus was improvised which satisfactorily removes all dust and loose particles on the surface, it is stated, without requiring any extra trips over the road.

The device consists of a small air compressor mounted on the oil truck itself and geared to its main driving shaft. From the pump compressed air is conveyed to a 1¼-in. pipe fixed horizontally about 2 ft. above the road surface and 2 ft. ahead of the oil spreaders. This pipe is perforated by 1/32-in. holes spaced 1¾ in. apart. The air is delivered at a pressure of about 30 lb. per square inch and is said to drive off a continual cloud of dust even when working over a surface on which ordinary inspection shows no appreciable quantity of dust particles.

LEVEE WORK in Louisiana from April, 1912, to April, 1914, involved the handling of 16,607,836 cu. yd. of earthwork at an estimated cost of $3,809,919.



UPPER-LEVEL PLATFORM FRAMING AT TWENTY-THIRD STREET AND THIRD AVENUE

Construction Methods Used in Building Parkersburg Reservoir

Holes for Light Blasts Were Put Down with Auger Bits—Concrete Was Carried to Place in Light Cars Running on Top of Narrow Wall

By L. E. CHAPIN
Engineer, Pittsburgh, Pa.

THE city of Parkersburg, W. Va., originally pumped water from the Ohio River through the distribution mains and into two steel tanks, each of 1,000,000 gal. capacity, located on the highest elevation in the central part of the city. These tanks, twenty or more years old, having been repaired from time to time by replacement, in part, of the upper sheets, burst in 1910, causing serious damage and some loss of life. After the destruction of the steel tanks, temporary storage upon the same location was provided by the construction of four small wooden tanks, and arrangements made to construct a masonry storage reservoir in a new and higher location. This was completed about two years ago and offered some interesting features in construction in the use of forms and the method of distributing the concrete.

The reservoir is located on the top of a knob, just beyond the north city limits and about two miles from the pumping station. The reservoir hill is at an elevation of about 140 ft. above the general level of the city, and the basin, when filled, has a water surface 255 ft. above the low water in the Ohio River at Parkersburg, and from 140 to 215 ft. above the greater portion of the city.

The reservoir is circular, 202 ft. in diameter and 26.5 ft. in depth below the top of the coping, with a capacity, at a depth of 24½ ft., of 6,000,000 gal., equal to somewhat more than two-days' supply, based on the average daily consumption.

EARTHWORK

The work was started by removing a large portion of the material to be excavated by slip scrapers and by the construction of a circular trench for the wall footings. This trench had a bottom width of 12 ft., outside slopes of ½ to 1, and inside slopes of 2 to 1. In it the footings and walls were constructed, using wooden forms for the footings, and Blaw steel forms for the vertical section. After the entire outer wall, with the exception of the closure distance of about 11 ft., was constructed, the core within the walls was excavated and moved by slip scrapers and delivered through a trap into a boot, and then elevated by means of a Jeffrey elevator and delivered over the top of the reservoir walls. It was there solidified by use of water and surfaced by slip scrapers to a uniform level, 5½ ft. below the top of the reservoir wall. The width of embankment is 14 ft., and the outer slopes 2 on 1.

After the grading was completed the 11-ft. gap was closed and the embankment completed.

The larger portion of the material excavated was a dense red clay and the lower 5 ft. a hard greenish clay resembling soapstone. It required blasting for its removal, but on exposure to frost and air decomposed, forming a clay which readily compacted in the operation of flushing and in the travel of teams in surfacing up the embankment.

This hard material was blasted by drilling 1.5-in. diameter holes to the subgrade, with a special auger bit driven by a gasoline engine. These holes were spaced about 5 ft. apart and required about 30 min. for an average depth of 5 ft. As the holes were drilled they were loaded and shot with black powder. The explosions did not disturb the underlying material, but broke evenly, so that it could be readily plowed and removed by the slip scrapers.

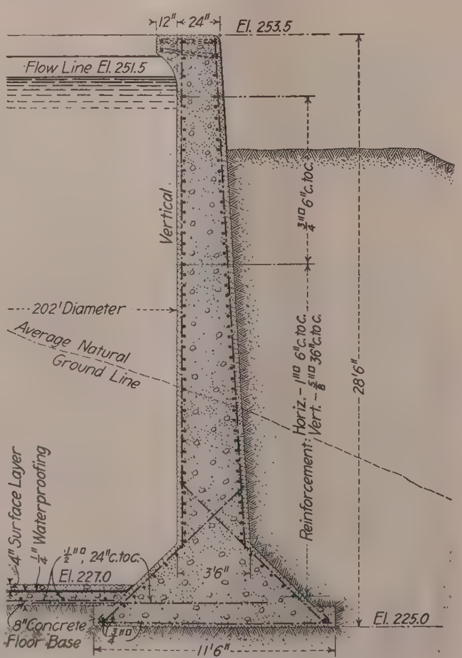
The subgrade was finished by picks, bars and shovels to the exact surface required for the bottom concrete.

WALL CONSTRUCTION

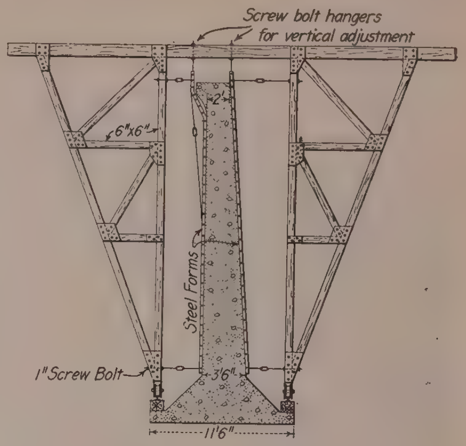
The footings and the sloping portion of the foundation were built with wooden forms, all in sections of 5 ft. in length. The upper 24.5 ft. of the wall was built with Blaw steel forms having panels 2 ft. in height and 5 ft. in length, bolted together and braced, forming two complete sections, each 25 ft. in length, one on each side of the wall. These completed sections were carried on and supported by an overhead traveler with side bents resting on sills, which in turn were carried on trucks. The track was built with 56-lb. rails, attached to ties laid on the upper part of the footing course. The traveler was moved along by a winch and lines.

FLOOR CONSTRUCTION

When the floor of the basin had been excavated to subgrade the concrete bottom was laid in two courses, the first, 8 in. deep, reinforced with ½-in. square rods. When the first course had been set up for two weeks it was covered with a ¼-in. waterproofing layer of Sarco asphaltum, poured hot and surfaced to a uniform thickness, which layer was extended up on the slope surface of the wall concrete.



CROSS-SECTION OF RESERVOIR WALL AND PART OF FLOOR



END ELEVATION OF WALL FORM

Then the wearing surface, 4 in. deep, was laid in 8-ft. squares, with ¼-in. joints. These were made by steel plates, which, when removed, allowed the joints to be filled with the asphaltum. When each section of the sidewall and each section of the bottom was completed and forms removed, the few rough spots found were plastered with cement mortar and the entire surface given two coats of cement wash.

WINTER CONCRETING

Concreting was carried on through the cold weather of December and January without difficulty by heating the water in the storage tank with live steam, giving a temperature of the mixing water for concrete purposes of 131 to 175 deg., and of the concrete when placed within the forms from 60 to 74 deg. At no time did the temperature of the concrete fall below 39 deg.

After each section had been filled with concrete coal fires were maintained for three days on each side of the forms and the heat retained by canvas covering.

TRANSPORTING CONCRETE

The first concrete was placed through three chutes directly from the mixer into the forms beneath. As the wall was extended track was laid on top of it and on the travelers, and the concrete moved in Koppel cars, propelled by a cable carried on drums, operated by a reversible friction gear connected to the mixer engine through a sprocket drive. The concrete was dumped through chutes directly into the steel forms, and also, through long chutes, for the footings to a distance of about 60 ft. ahead of the walls previously constructed. A Chicago No. 20 batch mixer, having a capacity of 15¾ cu. ft. of 1:2:4 concrete, was used. It was equipped with a 10-hp. engine.

Each section of the walls above the footing, being 25 ft. in length, contained 63.5 cu. yd. of finished concrete and was filled in in from 4½ to 6½ hr., depending on the haul from the mixer to the forms. The cars delivering the concrete over the top of the walls traveled at a uniform speed of 400 ft. per minute.

When concreting the floors a circular track concentric with the walls was laid on the subgrade. As the area was extended from the walls the track was moved, completing another annular area, until the entire bottom was concreted. In this manner about 90 cu. yd. was placed per day in the first course, and about 60 cu. yd. per day in the second, requiring 10 days to complete the first layer and 8 days for the second.

LEAKAGE TEST

The reservoir was completed on Aug. 1, 1913, and water immediately admitted to a depth of about 2 ft., and then drained off, removing the accumulated dirt from the pipe lines and reservoir bottom. It was then filled to its full depth and allowed to stand with all valves closed for five days, at the end of which time the water surface had lowered ⅝ in., partly due to evaporation and partly to slight leakage found through the 10-in. blow-off valve. On raising and reseating this valve all leakage through it stopped and the reservoir thereafter was found to be watertight.

The cost of the completed reservoir was about $53,000. Under the authority and direction of E. G. Stephenson, superintendent of water, and B. F. Stewart, city engineer, the plans were prepared and the work superintended by the writer. The contractors were the Nelson-Merydith Company, Parkersburg.

Expansion Joints in Lock Walls, Welland Ship Canal

EXPANSION joints in lock walls on the Welland Ship Canal have embedded in them a copper strip riveted to steel plates. The steel plates are embedded in the abutting masses of concrete on either side of the joint, while the copper strip is bent Z-fashion in the joint itself. At the start of the work 6 x ¼-in. plates were used with 16-gage copper. It was found, however, that these weights were heavier than necessary, and 6 x ⅛-in. plates and 18-gage copper are now used. The copper is riveted to the plates with ¼-in. rivets on 2-in. centers.

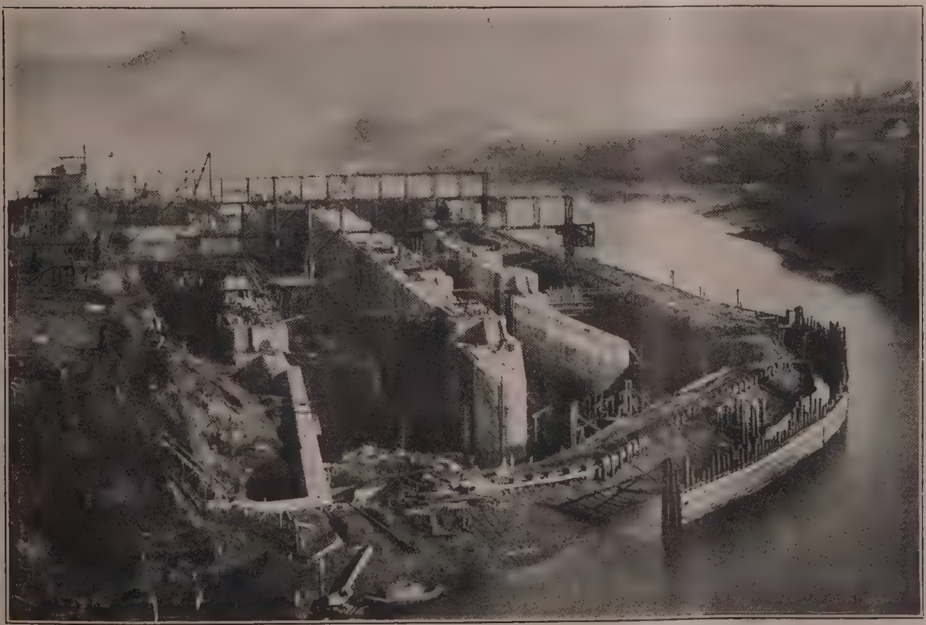
REFORESTATION IN NATIONAL FOREST RESERVES of the West has been carried on extensively this season, 14,000 acres having been planted with young conifers. The young trees were grown from seeds sown in hotbeds. The work of setting them out was begun early in the spring and extended over several months.

200,000 Yards of Concrete Placed for $800,000 in Lake Washington Canal Lock

Economical Mixing and Handling of Concrete, Using Very Large Gantry Cranes and High Trestles, Were Factors in Low Cost of Work at Seattle

THE EIGHT-MILE ship canal which is being built in Seattle to connect Lake Washington with Puget Sound involves the construction of a large lock near its lower end, and the 200,000 cu. yd. of concrete used in the construction of this lock have been placed at very low costs, the average being $4 per cubic yard. The plant for handling materials was designed as carefully as the concrete structure itself, and a feature of the scheme for delivering the concrete to all parts of the work expeditiously was a pair of steel gantry cranes each 264 ft. long, which stood 75 ft. above the floor of the lock, and traveled from end to end so as to be able to deliver loaded dump buckets to every part of the work. These cranes and all other construction plant used were included in figuring the cost of the work, only a small percentage of the original cost of equipment being deducted as probable salvage value. The work has been carried out under the supervision of the U. S. Engineer Department, but funds were supplied by the Federal Government and King County jointly for dredging a channel between the locks and Lake Washington.

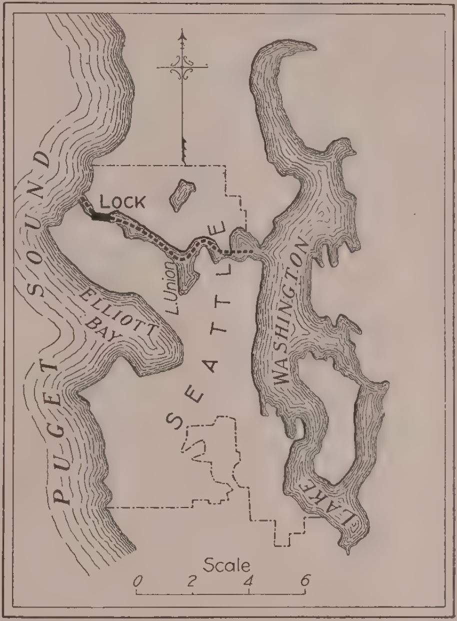
When the canal is completed it will create for Seattle a fresh-water harbor having an area of about 25,000 acres and a shore line 100 miles in length. The canal is, in reality, simply the improvement of the natural outlet of Lake Washington to make it suitable for shipping. The level of Lake Union, which is about 9 ft. below that of Lake Washington, will be made the new level for both lakes, and Salmon Bay, on Puget Sound, will connect with this level by means of the lock and dam now being completed. The depth of Lake Washington ranges up to 200 ft. as a maximum, while Lake Union has a depth ranging from 40 to 50 ft. Between the lock and Lake Washington 3,000,000 cu. yd. of material will be removed to provide a channel 100 ft. wide at the bottom and 36 ft. deep at low water. Below the lock 1,000,000 cu. yd. will be dredged out to form a channel 27 ft. deep at low tide and 150 ft. wide on the bottom.



AS THE LAKE WASHINGTON LOCK APPEARED FEBRUARY 23, 1915

GENERAL FEATURES OF LOCK

Some changes were made in the original design of the lock as first reported upon by Major H. M. Chittenden and described in the Engineering Record of Dec. 7, 1912, page 640. The main chamber, which will accommodate vessels up to 825 ft. in length and 80 ft. in width, will have a free depth of 36 ft. Alongside the main lock is a much smaller lock suited to vessels with drafts up to 16 ft.; its inside dimensions are 30 x 150 ft. The large chamber can operate on effective lengths of 375, 450 and 825 ft. by means of its upper, lower and intermediate gates.



LOCATION OF THE LOCK

The dam between the lock wall and the south shore is 225 ft. long, and is provided with a spillway to maintain the level of the upper pool within limits of about 1 ft. of mean stage. Emergency dams are provided at the upper entrance to the large chamber and at both upper and lower entrances to the small chamber. The gates in the large chamber have a double skin, the heaviest leaf weighing about 200 tons. The gates and pumps will be operated entirely by electric power, a total of about 540 hp. being required, which is distributed from a central power house. The pumping equipment, comprising one 2½-in., one 10-in. and two 30-in. centrifugal pumps, will have a total capacity of 23,000 gal. per minute.

The large chamber will be filled by means of 8.5 x 14-ft. culverts, which extend almost the entire length of both walls. These communicate with the chamber through a number of small openings above the floor of the lock. Similar culverts 4.3 x 6 ft. in section will be used for the small chamber. In the large chamber the culverts will be controlled by Stoney gate valves, and the smaller one will be served by cylindrical valves. Both types will be raised by means of screws controlled from operating stations on the walls. Three of these stations for the large chamber are on the north wall, while a single station between the two locks serves the smaller chamber. The lock gates are to be actuated by cables attached near the outer end of the toe on each leaf. As the gate swings through its arc of revolution the length of outstretched cable will change, and the radii of the drum spiral are so proportioned as to take up the slack due to such changes in cable length.

EXCAVATION AT LOCK SITE

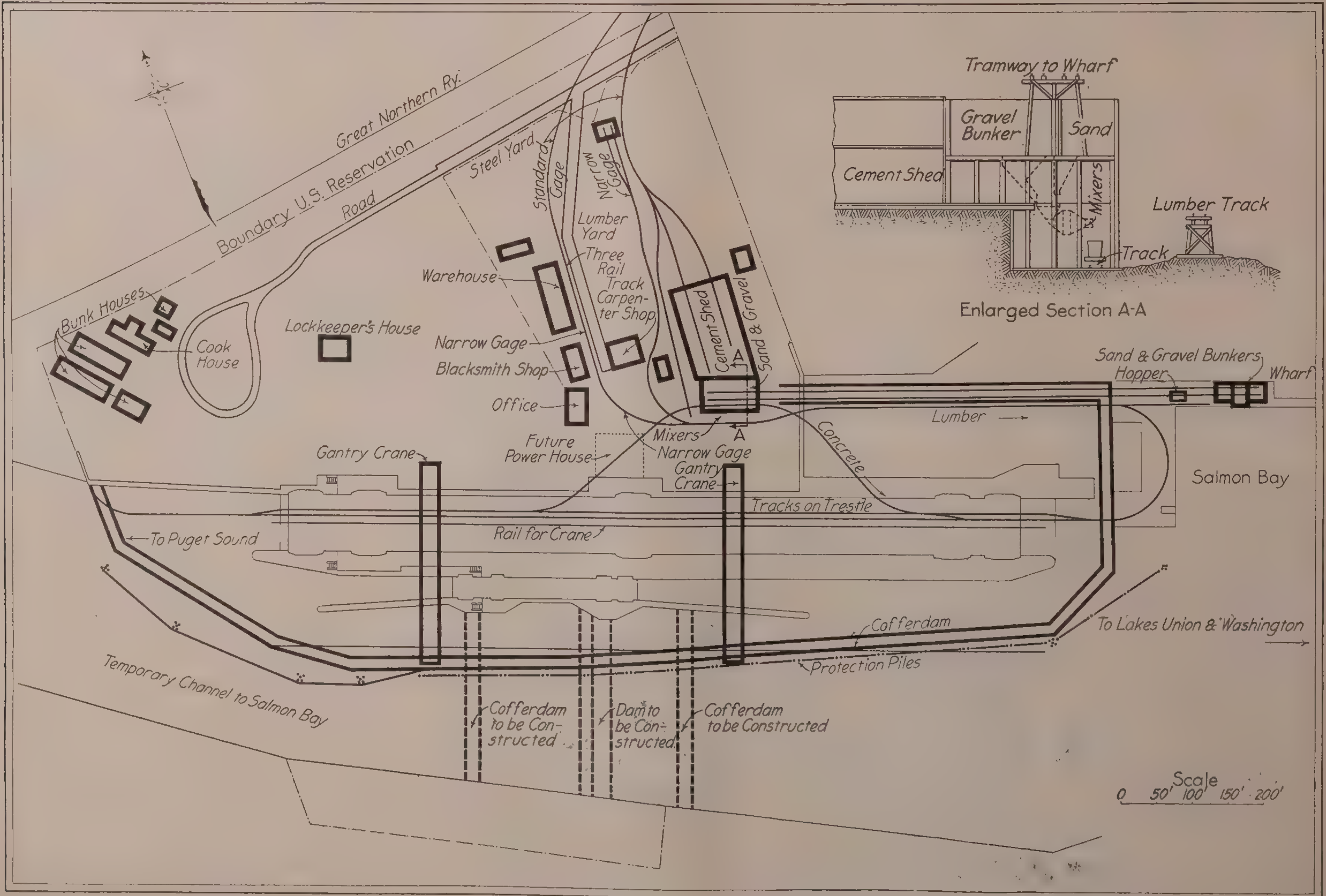
Excavation at the lock site was carried out within the protection of a cofferdam built in the shape of a square-cornered letter C. The total length of cofferdam required was about 1350 ft. The cofferdam walls, which are 20 ft. apart, were made by driving three thicknesses of 4 x 12-in. planking in the form of Wakefield sheet piling, some of which is 60 ft. in length. The filling required was supplied from the excavation, clay being used where possible. At high tide the bottom of the excavation was 58 ft. below water level, but no seepage difficulties were experienced. The cofferdam area was unwatered by one 8-in. and two 12-in. electrically driven centrifugal pumps, after which a single 2-in. centrifugal pump, running two eight-hour shifts per day, handled all the seepage.

VIEW AT WEST END DURING THE CONSTRUCTION OF THE GUARD GATES

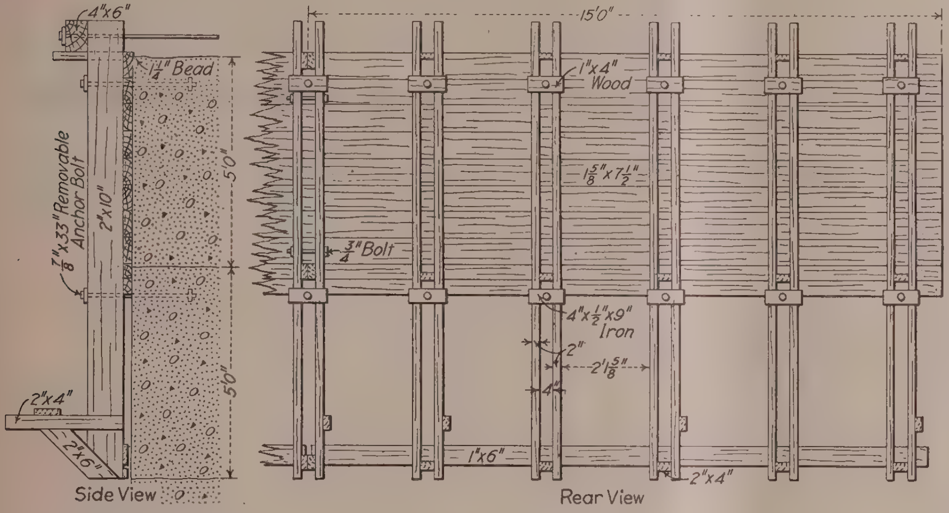
Under the protection of the cofferdam the excavation was completed to the required depth, and the erection of the two steel gantry cranes for distribution of concrete was begun. The cranes stood athwart the lock and were designed to move on a track running lengthwise with it, one rail being inside and just above the floor level, while the other was laid along the top of the cofferdam on the south side. These cranes, which weighed about 100 tons each, had a 176-ft. span between supports, and 88-ft. cantilever arms; their clear height above the rail was 75 ft. Each was equipped with two 30-hp. electric hoists and two separate trolleys, each capable of lifting 5 tons. The cranes were moved along the track by disconnecting one of the hoists from the trolley cable and coupling it to the mechanism on the cofferdam rail truck.

The cement receiving shed and store house, into which a spur from the Great Northern Railway was built, stood on the hill to the north of the excavation, about on a level with the top of the lock walls, and had a capacity of 20,000 bbl. The mixing plant was so placed that hand trucks on roller bearings conveyed the cement on the same floor level from storage room to the measuring hoppers above the mixers. Beside these hoppers were the devices for measuring water, and the hand levers which admitted sand and gravel from the bunkers above into the measuring and charging hoppers beneath.

Sand and gravel were brought to the lock site on barges, which tied up at a



IN THIS PLAN PERMANENT LOCKS ARE SHOWN LIGHT WHILE TEMPORARY WORK AND CONTRACTOR'S PLANT ARE SHOWN HEAVY wharf built out from the Salmon Bay end of the cofferdam. On this wharf two bunkers with a combined capacity of 600 cu. yd. were built, one of them being divided by a partition so that altogether three separate compartments were available. Into these bunkers sand and gravel were loaded from the barges by a 1½-yd. clamshell bucket operated by an electric hoist. The bunkers discharged into 3-yd. automatic side-dump cars which operated on two tracks running under the bunkers and up a 7-per cent incline 800 ft. long, to the 2000-yd. bunkers over the measuring hoppers. A two-drum electric hoist at the upper bunkers operated these cars, and it is said that with this arrangement, which called for only one attendant at the hoist and one at the lower bunkers, 1200 cu. yd. of sand and gravel could be handled in an eight-hour shift.



WALL FORMS WERE CHIEFLY OF CANTILEVER TYPE, IN 15-FOOT SECTIONS

With a few exceptions for special work, the concrete mix used in the lock was 1:3:6, or six sacks of cement per 1½-yd. mixer charge. Each mixer required five men for its operation; one at the mixer discharge lever, one measuring and dumping the charge into the mixer, two dumping the required proportion of cement into the measuring hopper and one wheeling cement from the warehouse. The mixing battery consisted of three 1½-yd. Smith mixers, each driven by a 25-hp. motor. The mixers were located directly under the sand and gravel storage bins and were set with their centers 20 ft. apart so as to discharge directly into dump buckets on flat cars which coupled up with a spacing of 10 ft. on centers.

Three trains of eight cars each were used. Each train carried six buckets, providing for the drawing of two batches from each mixer; the two additional cars made it unnecessary to keep the train waiting while the gantry crane returned the last two empty buckets. Thus with six loaded and two empty cars a train would run under a gantry and receive on the empty cars the buckets which the gantry was waiting to dispose of. The loaded buckets were removed by the gantry, two at a time, and returned empty. As soon as the gantry picked up the last pair of loaded buckets, the train pulled out with six empty buckets and two empty cars.

In order that these trains need not climb grades in conveying concrete from the mixers to the cranes, a trestle was built on the inside of the lock for its full length. This trestle was about 46 ft. high. The gantry cranes, which remained stationary while handling concrete, could deliver loaded buckets to any point in the cross-section of the lock. With this equipment as high as 1140 cu. yd. of concrete has been poured in an eight-hour day, the highest monthly record being 23,591 cu. yd. Approximately 150,000 cu. yd. of concrete was placed in the nine months between May, 1913, and January, 1914.

CANTILEVER FORMS

The walls for the most part were concreted in 30-ft. lengths and the concrete was deposited in layers 5 ft. thick. The tops of layers in adjoining sections were kept at approximately the same level, and numerous bonding blocks 2 ft. square were allowed to project upward into the next layer poured. The forms were chiefly of the cantilever type, built in sections about 15 ft. long; they were fastened to the wall with ⅞-in. bolts 2 ft. long with threads on both ends. On the inner end a 3-in. square nut ½ in. thick was used, and this was left in the concrete when the bolts were removed. The bolts were removed after the forms had been taken off and were used again repeatedly. The bolts were coated with tallow just before placing the concrete and to break the bond they were given one turn about four or five hours after the concrete was poured. Each form was used about five times and then knocked down, the lumber then being used for built-up forms at the backs of the walls.

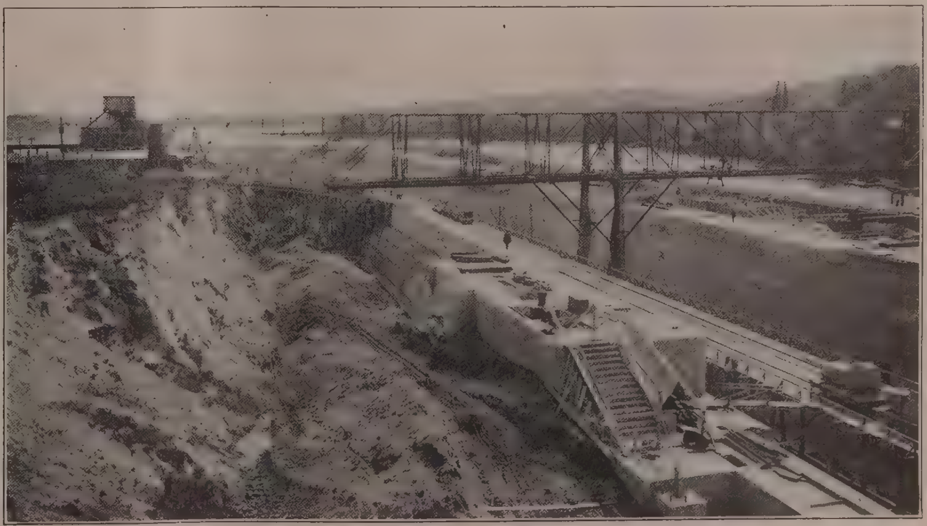
Where the width of the lock walls was not greater than 30 ft. tie rods were used to prevent the spreading of forms on opposite sides of the wall. These rods were spaced ten apart. The cantilever forms used were made up in slabs or sections 30 ft. long and 5 ft. wide. The form sections consisted of bevel-edged plank 1⅝ in. thick, placed horizontally and united by 3 x 10-in. uprights placed 3 ft. apart. The beveled edges left the face of each plank wider than its back in order to get a tighter form joint and give the concrete a better finished surface. This lumber was run at the mill specially for this work and cost about $12.50 per thousand delivered at the lock.

COST OF MATERIALS

The first concrete was poured in the locks in February, 1913, and in November, 1914, 200,000 cu. yd. had been put in place, practically completing the locks. The number of men employed on the work varied from 150 to 300. Sand and gravel cost 34 cents per cubic yard delivered on barges at the lock site. Cement cost $1.52 delivered on cars in the warehouse, and lumber costs were between $12 and $13 per thousand. The average cost of concrete in place in the lock was $4 per cubic yard, although for five months at a time the average had been as low as $3.70 per cubic yard. This figure includes all materials, reinforcement, form lumber, power, light, labor, overhead charges and practically the whole cost of the equipment used on the work, only a slight percentage of this latter item being written off as salvage.

The building of the lock was conducted entirely by hired labor under the direction of Major J. B. Cavanaugh, Corps of Engineers, U. S. A., A. W. Sargent, assistant engineer, being in local charge. C. A. D. Young, assistant engineer, was in charge of the design and erection of the gates and machinery.

PANAMA CANAL TRAFFIC established a new record in May, when 141 ocean-going vessels passed through. The previous record was 136, for the month of March. The March cargo exceeded that of May, being 635,057 tons, as against 578,708 tons in May. The total tonnage from the opening of the canal to June 1 was 4,347,568.



ONE OF THE GANTRY CRANES, AND THE TRESTLE FOR CONCRETE TRAINS

Rerating a Pitometer

Home-Made Whirling Apparatus Enables Sacramento Engineers to Calibrate Instrument After Slight Belling of Orifice

By CHESTER GORDON GILLESPIE
Assistant City Engineer, Sacramento, California

BY WHIRLING a pitometer in 18-in. of water on a 10-ft. arm of a home-made "merry-go-round" the city engineers of Sacramento, Cal., were able to rerate a pitometer, the orifices of which were slightly belled as a result of reaming out small burrs and irregularities about the mouth edges. The instrument was to be used in testing a new 15,000,000 high-pressure, centrifugal unit at the municipal pumping station.

"Merry-Go-Round" Used

The "merry-go-round" consisted of a 10-ft. arm of 2 x 6-in. scantling, reduced in width at the end, to which the pitometer was attached vertically by using a corporation cock screwed into the arm. The arm was rigidly cleated by an iron stirrup to the 4 x 6-in. central shaft, 6 ft. long. A ⅝-in. pin in the bottom of the shaft rotated in a cup bearing, a hole drilled in a steel plate. The whole arrangement was carried on a pier of four piles, driven in the lake bottom. On top the shaft was steadied by an overhead T-frame carried on two posts and a tree, spread enough to clear all moving parts. Double 2 x 8-in. timbers, about 20 ft. long, were required for stiffness of the frame.

Rotation was secured and regulated by the use of a drill press, bolted to a standard above the shaft, connection being made with the shaft by a tongue and jaw arrangement, intended as a slip joint to prevent binding of the bearings when the operator's weight came on the framework.

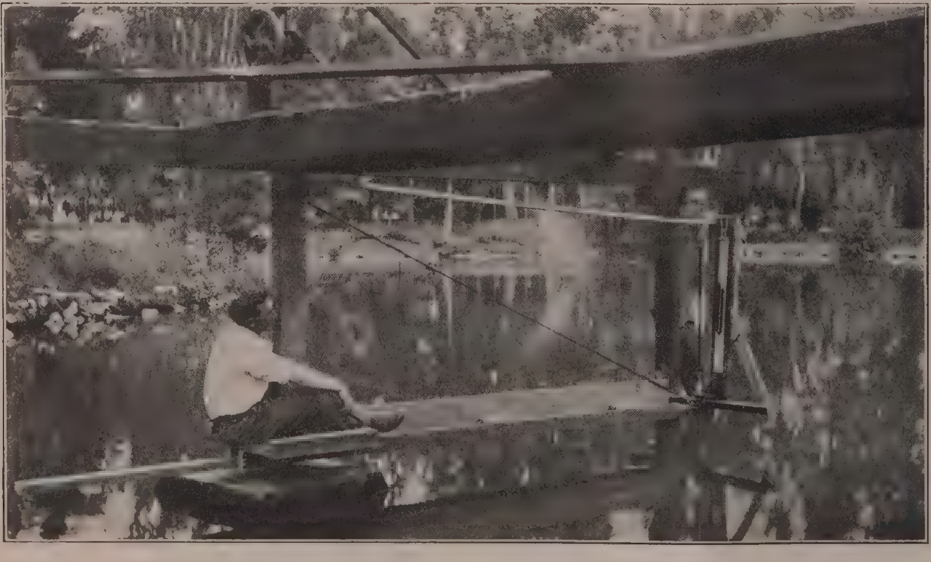
The pitometer, about 6 ft. long, was steadied by a post at the end of the 10-ft. arm, and braced to a transverse bar nailed to the arm. This bar was used to adjust the plumbness of the pitometer by counterweighting one end.

Observer Whirled with Pitometer

Rubber-tube connections were made from each orifice tube to respective legs of an inverted glass U-tube mounted on a scale board. Deflections produced by the rotation were read by using colored carbon tetrachloride, the observer sitting on a revolving platform built around the shaft. Particular pains were taken to free the system of air. The U-tube was of a uniform bore, and hence knowing the neutral reading it was merely necessary to read the column in one leg, multiplying the difference by two to get the total deflection. The truth of this was tested at several ranges of readings. Deflections were read in every quadrant and the rotation time for a series taken by a stop-watch by the observer. Readings were set down by a recorder stationed above. About seven revolutions made a test.

Linear velocities ranging from 3.67 to 6.69 ft. per second were used, giving a deflection of from 5.58 to 18.68 in. The maximum variation in the determined coefficient was from 0.860 to 0.870, averaging 0.866. As given by the makers the coefficient was 0.84, showing the belling increased the value 3 per cent.

Including engineering, carpenter, foreman and all expense, the rating cost $90. It was carried out under the general direction of F. C. Miller, city engineer, by the writer.



THIS "MERRY-GO-ROUND" WAS USED FOR RERATING PITOMETER

Literature

For the Civil Engineer and Contractor

New Publications

Water Purification Plants and Their Operation. By Milton F. Stein, assistant engineer, Cleveland Filtration Plant. Cloth, 6 x 9 in.; 258 pages; illustrated, diagrams and plates. New York, John Wiley & Sons, Inc. $2.50 net.

Manual of Surveying for Field and Office. By Raymond E. Davis, C.E., instructor in civil engineering, University of Illinois. Limp leather; 4 x 6¾ in.; 395 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $2.50 net.

The Slide Rule—A Practical Manual. By Charles N. Pickworth, editor of "The Mechanical World," author of "Logarithms for Beginners," "The Indicator," etc. Thirteenth edition. Cloth, 5 x 7 in.; 122 pages; illustrated. New York, D. Van Nostrand Company. $1 net.

This revised edition has been extended to include descriptions of various new slide rules and calculators. A note on the extraction of fifth roots has also been added.

Standardized Square Footings of Reinforced Concrete. By Lewis A. Hicks, structural engineer. Paper, 6 x 9 in.; 62 pages; illustrated. San Francisco, Lewis A. Hicks Company, Rialto Building.

A thorough explanation of the use of diagrams devised for the solution of problems in connection with the design and review of square footings, principally in the form of two-line nomographs. The book is accompanied by a line sheet containing nomographs for stresses and design data. Most of the formulas are in the form proposed by Prof. A. N. Talbot in Bulletin 67 of the University of Illinois based on the only series of tests on column footings ever made.

The Economics of Contracting, Volume II. By Daniel J. Hauer, consulting engineer, editor of the "Contractor." Cloth, 6 x 9 in.; 324 pages and appendix; illustrated. Published by H. E. Baumgartner, Rand-McNally Building, Chicago. Price, $2.50.

The general estimate of this book will be found in the editorial pages of this issue. In addition to the sections there commented upon, the work contains much valuable information on filing systems, and the organization and conduct of the executive functions and offices of a company. Valuable, and at times amusing, suggestions for handling customers are also presented. An appendix contains suggested by-laws for a construction company. The author's handling of English is not equal to his mastery of the principles of conducting a contracting business; the presentation is, however, clear and forceful.

Books Reviewed

Experience in Efficiency

Author, Benj. A. Franklin. Cloth, 5½ x 8 in.; 168 pages. New York, Engineering Magazine Company. $1.

This is a good book for the unbeliever in modern methods of increasing efficiency to start on. It will lead those back to conviction, too, who have lost their keen appreciation of the possibilities offered by thorough studies of business, industrial, and contracting operations.

Mr. Franklin tells simply and interestingly what has been accomplished in various plants by efficiency studies. Moralizing and theory are indulged only to a limited extent—sufficient to bring out the philosophy of the procedure and indicate the general principles involved in the specific cases cited. The variety of studies is such as to be suggestive to men in widely different branches of industry.

Cases are cited where efficiency has been increased by setting piecework prices on the basis of quality, by setting piecework prices on the production of whole gangs instead of individuals (a method that can frequently be used in contracting work), by scheduling the clerical force, by installing work-order systems and inspection departments, and by putting a whole plant, including the office, on bonus (a most unusual procedure). Mr. Franklin's views as to when additional clerical hire, for the purpose of developing statistics looking toward closer control of operations and reducing costs is justifiable, are very sensible and deserve a wide reading. A story on overhead reduction in a certain plant is particularly good, and will hold the interest of those who are constantly worried by the bugaboo of ascending "burden." Finally, Mr. Franklin emphasizes the need for the proper mental view in order that betterment studies may succeed.

While the incidents relate only to industries, they will start trains of thought for the civil engineer, particularly those in authority on municipal work, and for the contractor. The latter, unfortunately, has been slow to learn the value of minute analysis of his operations, and to him the discussion on gang bonusing and on the advisability of clerical hire should prove especially valuable.

Sanitation in Panama

Author, William Crawford Gorgas, Surgeon General, U. S. A. Cloth, 7½ x 5 in.; 298 pages, 15 illustrations. New York, D. Appleton & Co. $2.
Reviewed by George C. Whipple, Professor of

Reviewed by George C. Whipple

Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

The story of sanitation in Panama has been told repeatedly, but never so well or so completely as in this new book by Major-General Gorgas, the master of sanitation. It is written in a popular style adapted to the general reader and is an intimate personal account of General Gorgas' work both in Havana and Panama. Although written as a narrative it is, nevertheless, thoroughly scientific and orderly in arrangement. Starting with the old ideas in regard to the transmission of yellow fever, he describes step by step the scientific work which placed the mosquito theory on a firm foundation. He shows how sanitation without a knowledge of the mosquito theory failed to eradicate yellow fever and how triumphant was the conquest of this disease after the Reed board had finished its work. Incidentally General Gorgas discusses malaria, plague, and other diseases, and of course describes in detail the work of the sanitary department, thus making the story complete.

In his concluding paragraph the author makes a statement that will at first seem extravagant, namely, that the elimination of tropical diseases is as important to the human race as was the discovery of America by Columbus in that it has opened to human habitation the immense areas of productive land in the tropics hitherto uninhabitable by white men.

The Essentials of Descriptive Geometry

Author, F. G. Higbee, professor and head of the department of descriptive geometry and drawing, State University of Iowa. Cloth, 6 x 9 in.; 204 pages; illustrated. New York, John Wiley & Sons, Inc. $1.80 net.

The principal object of this book, as stated by the author, is to develop the qualities of mind so essential in a draftsman—ability to solve problems, to visualize and to analyze a complex problem into its component parts. The book, therefore, confines its practical treatment to the third quadrant and includes those parts of the subject which possess industrial utility. The most distinctive feature is the extensive treatment of model making. Models are illustrated and many problems given, presumably with the purpose of aiding the student to obtain a clear understanding of the relation between the drawing and the actual object pictured. Practical problems are suggested and the text, after Chapter 7, is consistent in method of treatment in first stating a problem in the form of a "proposition," then outlining the method of solution in a "discussion" and finally describing the construction in detail.

The treatment as a whole is logical and essentially elementary in method of presentation. Particular care is devoted in the opening chapters on orthographic projection and the profile plane to create a clear conception of the elements upon which the whole subject depends. The chapters are short and always contain from ten to twenty problems each. After several chapters on separate propositions, Chapter 10 gives a thorough discussion of problems in points, lines and planes. The following five chapters are then devoted to planes, cylindrical and conical surfaces and their intersections.

Surfaces of revolution and warped surfaces are clearly defined and classified. The more usual and simple forms are discussed in full, the warped surfaces being clearly illustrated by models. The helix and the helicoid are included in detail, and the development of surfaces is illustrated. In the chapter on model making many practical suggestions and examples are given, including such problems as ventilator cowls, hoods, elbows, etc. The book closes with an appendix containing rather simple constructions usually given under plane geometry, but repeated for ease of reference. The figures are clear and well drawn and the typography is good.

The Modern City and Its Problems

Author, Frederic C. Howe. Cloth, 5 x 8 in.; 390 pages. New York, Charles Scribner's Sons. $1.50 net.

Comment has been frequently made in this journal on the broadening opportunities for engineers in municipal work. The complexity and high first and maintenance costs of our public works, necessitating the highest order of engineering training; the better appreciation of the place of the expert in modern administration, whether private or public, and the advent of the commission and of the commission-manager forms of government are responsible for this. Undoubtedly the opportunities will be still broader when engineers grasp such as are now offered and show their ability to handle the broadest phases—financial and administrative—of municipal work.

Consequently, the "Modern City and Its Problems" deserves a wide and careful reading from engineers. Many of the activities of European, especially of German, cities enthusiastically described by Mr. Howe look to the conservative mind to be intensely fraternalistic. In the last analysis, however, it develops that they are carried on on good business principles or are unescapable to the municipality that appreciates its responsibilities to its citizens. If, as Mr. Howe believes, American cities will very considerably enlarge their scope in the near future, it is all the more important that engineers understand fully what the German and British cities can do, and how they do it. From their long experience and their many experiments he will be able the better to formulate his own plans and to judge of the success of new municipal undertaking.

In order to give a background for the latter discussion Mr. Howe first reviews the status of the ancient and medieval towns, and then faces the development of the modern American city. Turning then to Germany and Great Britain he contrasts their methods and their progress with our own. An analysis is then made of the causes of American municipal backwardness, with the conclusion that it is due very largely to the lack of home rule, to the interference of legislatures in municipal affairs and the extent to which they have circumscribed the liberties of the city government. Recent improvements along the lines of the Federal charter adopted by Cleveland and the commission-manager forms of administration are discussed at length. These chapters, giving Mr. Howe's explanation for the present situation of American municipal government and the changes for the better that are being wrought, should be of the greatest value to him who wishes to understand the problem of American municipalities. The city and the public service corporation are discussed in one chapter, much to the detriment of the latter, while municipal ownership in South America and Europe are quite fully discussed, the finding in general being in favor of public ownership of tramways and electric-light, gas and water properties.

Probably the chapters that will best hold the interests of our American engineers are those on the city as a social agency, the housing problem, municipal housing in Europe, recreation and the problem of leisure, the city budget and new sources of city revenue.

The progressive engineer engaged in municipal work cannot afford to be in ignorance of the matters Mr. Howe discusses in this book.

Government of the Canal Zone

Author, George W. Goethals, U. S. A. Cloth, 5½ x 8 in.; 106 pages. Princeton, N. J. Princeton University Press. $1 net.

This little book is a reprint of the Stafford Little lectures for 1915. The aim of the lecturer was to cover these phases of the Panama experience regarding which little has been written. The first lecture deals with the acquirement of the Canal Zone by the United States; the extent of the authority of the United States; the treaty with the Republic of Panama; the difficulties with the Panamanian Government over customs and postal matters, and their final disposition; the reasons for the successive changes in the administration of the zone, leading up finally to the establishment of the "benevolent despotism" regarding which so much has been written. The point is made clear that no other form, of the various experiments tried, served properly to secure the sole end of the zone's acquisition—the construction of the canal.

The second of the two lectures discusses the economic, political, and administrative situation on the Canal Zone which necessarily are determinative of the permanent form under which the canal is to be administered. Much argument is adduced from diverse points of view, to show why the zone should be depopulated, except for the maintenance and military forces, necessary for the operation and defense of the canal. Finally there is a discussion of the various forms suggested for the permanent government, and a description of that finally adopted and now in effect—a continuation of government by executive order, the general form under which the zone has been since April 1, 1915.

TEMPORARY RAILROAD TRESTLES and other construction to be assumed as necessary in estimating reproduction cost new for the Federal valuation must, it was pointed out at the recent valuation conference, be much heavier than were actually built when the older roads were constructed, on account of the much heavier equipment now used.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Railroad Field Data

SIR: In the notice of Professor Raymond's "Field Manual for Civil Engineers" in your issue of June 5, the reviewer expresses the opinion "that the exclusion of the exposition of typical curve problems will militate against its usefulness in the field." The writer believes this theory (apparently held by many of the instructors in our engineering schools) is erroneous, and he knows by reason of a long experience that if the students were well grounded in the theory and practice of geometry and trigonometry they would not need specific instructions in the details of each particular curve problem which comes up for solution. Any or all of these problems are most useful as practice problems to develop the student in the application of the theory to actual practice, but in the field all that should be needed is a book of the essential tables in the most compact form.

F. LAVIS.

New York City.

Promoting Engineering Work

SIR: I am writing to comment on the recent article by George R. Bascom of the Extension Department of the University of Wisconsin as to the work they are doing. (See the Engineering Record of July 3, page 47.) It occurs to me that the principle laid down by this department, as described by Mr. Bascom, is highly commendable.

I do not believe that any engineer in private practice will disagree with me when I say that the average City Council in any small community contemplating municipal improvements has to be educated as to the amount and method of necessary work in the proposed improvement. As a general rule they will listen to anyone representing or connected with a State educational institution in preference to an engineer in private practice. This puts the question in a very delicate position and is a revision of the old question as to whether or not instructors in the schools should solicit and do private work. I do not believe that it is so much the fact that this is done as the way it is done and the rates charged that have led to the strong feeling against it among consulting engineers.

The work of the above-mentioned Extension Department is an excellent solution to the problem, and I would like to see it started in this locality also.

E. B. MURRAY,
Consulting Engineer.

Kansas City, Mo.

SIR: I have read the article by George R. Bascom of the University of Wisconsin relative to the university promotion of engineering projects and the editorial comment thereon. There may be a difference of opinion as to the advisability of an educational institution, supported in part, at least, by State funds, engaging in the business of promotion, but there can be no question as to the fact that such promotion, as explained in the article, does infringe upon and conflict with the legitimate duties of the consulting engineer.

According to the statements made in that article the university furnished, free of charge, an engineer who made a study of the local problem, outlined a plan, which must have been in somewhat complete detail in order to base upon it the estimate furnished, and a report, the nature of which is not stated.

As a rule, and in this statement most experienced engineers will concur, the work alleged to have been done by the university representative covered about all the really expert knowledge required, because with the fundamentals once established the details can very safely be left to subordinates. In fact, the context shows that such was the case in Bloomington. It seems to the writer that it would have been more graceful, more dignified and more in keeping with the proper functions of an educational institution had its services terminated in giving advice.

When a State institution, whether quasi or actual, engages in the business of furnishing, gratuitously, designs, plans, estimates of cost and reports for physical structures, then it usurps and infringes upon the rightful prerogatives of a class of men who have spent many years and much money in acquiring expert knowledge of their professions. The practice is a reprehensible one and, regrettably, not confined to the State of Wisconsin alone. The advice frequently given to the individual to "mind his own business" is equally applicable to the State.

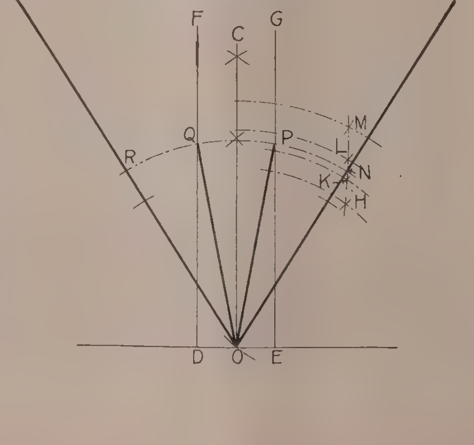
W. G. STONE, C. E.

Utica, N. Y.

To Trisect an Angle

SIR: The following simple and original solution of the problem to trisect any angle graphically may be of interest. In the accompanying figure, let *AOB* be the angle to be trisected. Draw *OC* so as to bisect the angle *AOB*, and draw through *O* a line perpendicular to *OC* and lay off $DO = OE$. Draw *DF* and *EG* parallel to *OC*, and with O as a center draw any desired number of concentric circles using any desired radii. From the points where these circles cut the line *GE* lay off chords on said circles equal to the distance *DE*.

Through the points *H*, *K*, *L* and *M* thus secured draw a smooth curve, and through the point *N* where this curve cuts the line *OB* draw a circle having *O* as a center and the distance *ON* as a radius. On this circle the cord $NP = PQ = QR$ and is also equal to the distance *DE*, and since equal chords subtend equal arcs the angle *ROQ* equals the angle *QOP* equals the angle *PON*, and the angle *AOB* is trisected.



By a similar theory and construction any angle may be divided into any number of desired parts.

B. K. COGHLAN,
Associate Professor of Highway Engineering, Agricultural and Mechanical College of Texas.
College Station, Texas.

Mortar Cushion Under Vitrified and Stone Block Pavements

SIR: I have noticed several references in your paper recently regarding mortar cushion under vitrified and stone block pavements. In this connection the city of Baltimore has completely changed its vitrified-block specifications this year and has laid all such material on a lean mortar bed mixed one of cement and five of sand. Ordinarily there is sufficient moisture in the sand to cause this to set, but additional moisture is added when the pavement is sprinkled before grouting. Pavements under traffic since the first of March have shown no signs of weakness whatever.

Some granite-block crossings in street-railway tracks have been placed on mortar bed this season, with excellent results, and we have recently awarded two granite-block contracts with the blocks to be laid on a mortar bed, the same mixture as that under the vitrified-block pavements.

I believe that all our block pavements in the future in this city will be laid on a mortar cushion.

R. KEITH COMPTON.
Chairman and Consulting Engineer, Paving Commission, Baltimore.

EIGHTY-FIVE MILLION FEET of Timber is to be cut from the Chugach National Forest in Alaska for use in constructing the Government railroad in that territory, a permit covering this having been granted the Alaskan Engineering Commission by the U. S. Forest Service. The cut will be the largest amount of timber ever felled on the Alaskan forests in one operation, and at the average rate obtained for timber sold from the Chugach forest during the fiscal year 1914, it is worth approximately $145,000 on the stump. It will be nearly twice as much as the total quantity of National forest timber now cut and used annually for local purposes throughout Alaska, but the two National forests of Alaska contain about 78,000,000,000 ft. of merchantable timber, and it is estimated by the Forest Service that more than 800,000,000 ft. could be cut every year, forever, without lessening the forests' productivity. Tests of Alaskan spruce and hemlock are being made at the Forest Service laboratory at Seattle, and so far have substantiated the opinion of foresters that Alaskan timber is sufficiently strong for practically all structural purposes. While these tests are going on Forest Service employees in Alaska are marking the timber to be cut along the proposed railroad, the cutting to be done so that only mature trees are taken, the young trees being left uninjured and the condition of the forest being improved.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Concrete Patches Repair Centrifugal Dredging Pump

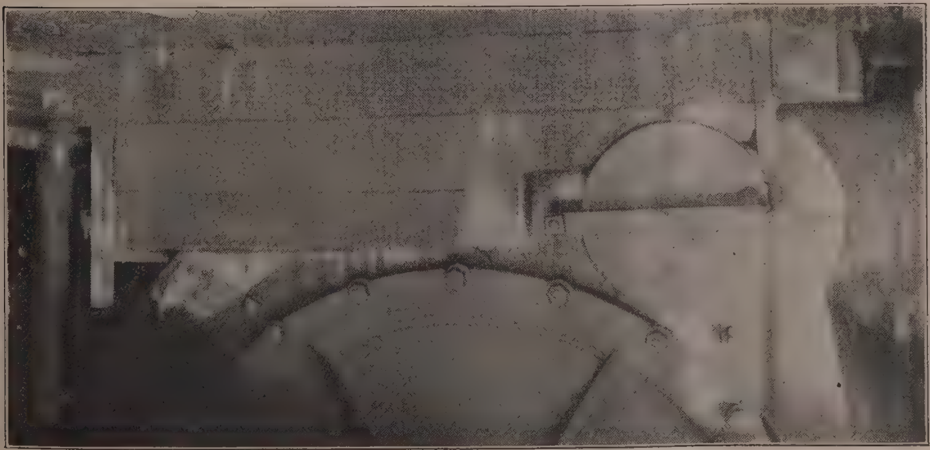
By W. L. GRACE
Erie, Pennsylvania

CONCRETE mortar has been used with success to repair temporarily a cracked centrifugal pump casing on a hydraulic dredge working in the Erie Harbor. A crack had started in the lower part of the casing, which was rapidly extending, and a piece of the casing threatened to break out. To avoid shutting down the pump, a wooden form was built around the cracked part of the pump casing, allowing a generous margin all around the break, and poured full of a wet mixture of 3½ parts of cement to 1 of sand. This was allowed to set for twenty-four hours, after which the pump was started up. In about four days the vibration broke the bond between the cement and the pump casing. The crack between the cement and the casing was, however, readily stopped with sulphur, which at once made the patch tight. So far this repair has proved very effective.

At the same time a "Y" in the discharge line, which had been patched before but was again nearly worn through, was given the same treatment. This patch proved even more effective than that on the pump casing, as the bond between the cement and the iron is still holding.

To take this pump casing off and weld it would have required considerable time. Now, however, the pump can be kept in operation while a new casing is ordered at the leisure of the owners.

CONCRETE PATCH ON DISCHARGE LINE



CRACKED PUMP CASING PATCHED AIRTIGHT WITH CEMENT MORTAR

Record Form Helps Contractors to Bid on Highway Work

By T. EADINGTON
Occidental Construction Company, Los Angeles, California

THE ACCOMPANYING record form has been found valuable by California contractors for keeping track of the prices at which work was actually going in different sections of the State, so that they might know what figures they would have to beat if they expected to land a given job. This has been necessary lately, as the dearth of work along other lines has caused contractors to turn their attention to the roads which are being built all over the country. The result has been keen competition and ruinously low prices. The contractor has to consider, not how fair a margin he can secure, but how low the other fellow is going to bid, and how near he can come to him and still make something on the job.

Most of the work in California consists of grading and laying a 4-in. concrete pavement, the State in recent months furnishing all material for the pavement. The form shows the location of the job, the contractor's price and the engineer's estimate, and gives in detail the unit prices, the top line showing the contractor's unit price and the second line that of the engineer.

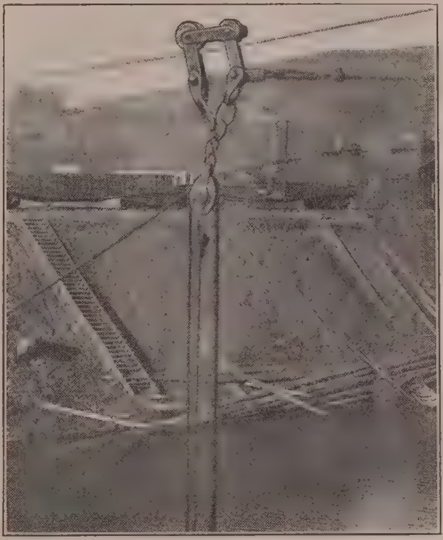
STATE HIGHWAY WORK—CALIFORNIA

Date	Location	Miles	Contractor	Price	Excavation per cu. yd.				Concrete		Pavement, sq.yd.	Oil surface
					Unclassified	Earth	Soft rock	Hard rock	A cu.yd.	B cu.yd.		
Apr. 24, '15	Yolo - Sacramento River, Yolo County, California	3½	Engineer's estimate..	$38,637	$0.50	....	....	....		$7.25	$4.08½	....
			J. Lawrence	24,205	0.86¼	....	....	....		6.00	2.85	....

Home-Made Cableway Changes Shafting on Caisson Job

By H. D. HAMMOND
Associate Editor, "Engineering Record"

A CABLEWAY, made of a spare 1½-in. galvanized derrick guy, and operated by nigger-heads on two hoists already set up on the job, was used with success by the writer in sinking one of the caissons for the Pennsylvania Lines bridge over the Muskingum River near Coshocton, Ohio.



CARRIAGE STAYED ON THE TRACK

The new piers were sunk beneath a double-track main line in full operation. Shafting, cofferdam, etc., was, of course, built up as the caissons were sunk. A derrick was set up to handle locks and shafting at each end of each abutment, at the upstream end of pier 1, and at the downstream end of pier 2. Each of the piers had two airshafts, but as the downstream end of pier 1 was nearly under the old truss span at that point, it could not be reached by a derrick. Consequently, the shafting and a light man-lock used for this end were handled on tackle swung from the bridge floor.

Pier 2 required practically the same equipment. Two exits from the working chamber were necessary for safety, and for changing crews. The excavation, however, was mostly taken out with a blow-pipe, and the amount of material to be bucketed did not warrant setting up two derricks. The span over this caisson, which was of plate girders on pile piers, was narrow enough to allow reaching the downstream end with

CABLEWAY SAVED ERECTING DERRICK TO HANDLE SHAFTING AND TIMBER

a derrick. The upstream shaft was well out from the bridge, and this end of the caisson was in deep water where derrick staging would have been expensive. A gin pole was considered for changing shafting on this end, but would not have been a good rig for several reasons. The sections of shafting had to be floated alongside the caisson on rafts, raised and carried to the center of the caisson for erection. Besides, a gin pole could not be left standing on the caisson while it was going down. Neither could it be laid down on top of the caisson when not in use, as the carpenters building up the caisson cofferdam would have had to raise the pole every time they put in cross braces, to avoid leaving it where it could not be removed.

The cableway was strung from the portal of the west truss span to a bridle at the base of the mixing plant at the west abutment. This bridle was anchored to two piles already in place. The cable was arranged to hang as nearly as possible over the center of the shaft by slipping it on the bridle. The cable led down grade from the bridge truss. The carriage was made in the job blacksmith shop out of two small sheaves, some strap iron, two shackles and three links. From it hung a four-part manila rope fall, the lead line of which ran across the river to a hoist set up at one of the derricks for the west abutment. To prevent this line from sagging, it was led through two or three snatch blocks hung at intervals from the main cable between the pier and the west bank. To the carriage was fastened another line which led, in the opposite direction from the lead line, back to the bridge portal, across over the tracks, and down to the hoist at pier 2. This line pulled the carriage uphill. A slight tension on the fall line would pull the carriage downhill, and if carrying a load, the carriage would run downhill of its own accord.

To insert a new section of shafting in building up the caisson, the man-lock would first be removed and set on top of the caisson. The rope leading to the hoist at pier 2 would then be slacked till the carriage ran downhill over the raft, carrying the new section of shafting, on the west side of the caisson. This shaft would then be picked up, and the carriage pulled back over the caisson. The shaft would then be bolted in place, and the lock replaced on top of it. The sections of shafting, which were 4 ft. in diameter and 10 ft. long, weighed about 1800 lb.

The rig was new to the men using it, and caused a great deal of trouble in setting the man-lock for the first time. It was difficult to make the load hang level and swing it so as to match up the bolt holes without disturbing the gasket which had to be made up in the joint. After the first shift was made, however, shafting was inserted almost as readily as with a derrick, and a shift was even made at night on one occasion. The cableway also proved of great use to the carpenter gang, as it enabled them to set the 12 x 12-in. braces in the upper end of the cofferdam sections without having to slide them through under the tracks from the downstream end.

The work of building these bridge foundations was carried out by the Foundation Company, with Reginald Jackson superintendent. The writer, who rigged the cableway, was general foreman.

Mixer Plant on Flat Car Propels Itself Along the Job

By F. E. CANTWELL

Dominion Equipment & Supply Co., Winnipeg

IN ORDER to shift their concrete mixing plants over a distance of 17¾ miles in the construction of the Shoal Lake-to-Winnipeg Aqueduct, near Winnipeg, Canada, the contractors, Thomas Kelly & Son, have had three special self-propelling mixer car plants built. The Chain Belt mixers are mounted on 35-ft. standard gage, 60,000-lb. capacity flat cars. The water tank shown in the accompanying photograph on one end of each car has a capacity of 3000 gal. The mixer and boiler are fed from this water supply by a duplex steam pump. Piping is so arranged that the overflow from mixer tank is carried back to the water tank. Concrete is shot direct from the mixer to the aqueduct forms through special "U" shaped No. 10 gage steel spouts, each 18 ft. 9 in. long, made in two sections, rolled to 24 in. diameter with a depth of 8 in. They are reinforced on each side with angles, with holes punched every 6 in. for attaching supporting cables.

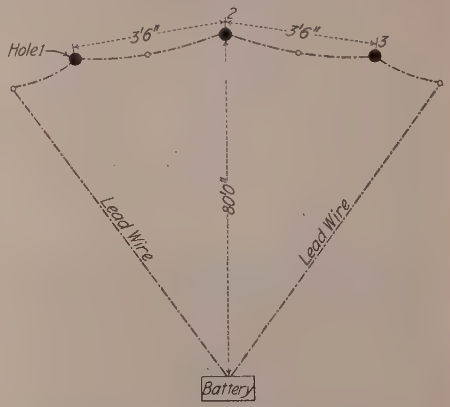
THESE MIXERS SERVE A 17-MILE JOB AND CARRY THEIR WATER WITH THEM

A Blasting Puzzle

By L. C. SCOTT

Engineer, Linn Creek, Missouri

THE following phenomenon actually happened. Can any of the readers of Engineering Record explain it? Holes 1 and 3 in the drawing were shot simultaneously and hole 2 went off 2 min. after the others had gone and with no apparent cause. Electric fuses were used and wired as shown. The first explosion threw the lead wires high in the air and entirely away from holes. The holes were 1¼ in. in diameter, 3 ft. deep and were loaded with two sticks, split open, of 40 per cent DuPont dynamite. The battery contained six dry cells with coil. Holes 1 and 3 shattered the rock over the top of hole 2 and when hole 2 went it apparently had full strength. The rock is hard limestone.



CENTER HOLE FIRED ITSELF

Why did not all holes go at once, and, failing to do so, why did hole 2 go 2 min. later without an application of electricity?

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

To Submit Plans for $10,000,000 Power Development Project

It is reported that the Ontario Hydroelectric Commission will submit plans to the Ontario Government within the next week, which provide for eventual power development at Niagara Falls and from the stillways of the New Welland Canal of 250,000 hp. and an immediate development of 100,000 hp. The work will entail an expenditure of approximately $10,000,000, and will require three years to complete.

Of the power available on the Canadian side of the falls, under the treaty between the United States and Great Britain made some years ago, only 6600 sec.-ft. are left at the present time. Plans have been made for the utilization of this up to the limit by getting the greatest possible head of water. The plans, which will be submitted to the Government, will be capable of extension to develop ultimately 600,000 hp. This includes the 6600 sec.-ft. at Niagara and water that has been promised from the spillways of the Welland Canal. The chairman of the commission predicts that when this new development gets beyond the initial stage there will be a sweeping cut in power prices.

It is understood that the plans of the commission call for the construction of a great development plant at Chippawa Creek.

Chicago's Abolished Efficiency Division Revived Under New Title

An ordinance calling for the establishment of a Board of Standards and Apportionments and appropriating $15,000 for expenses has been passed by the Chicago City Council. The board will be under the supervision and control of the city comptroller and a representation of the council committee on finance, consisting of the chairman and three members. The duties of the new board are similar to those of the efficiency division, abolished several months ago by the new city administration, as is indicated by the following excerpt from the ordinance:

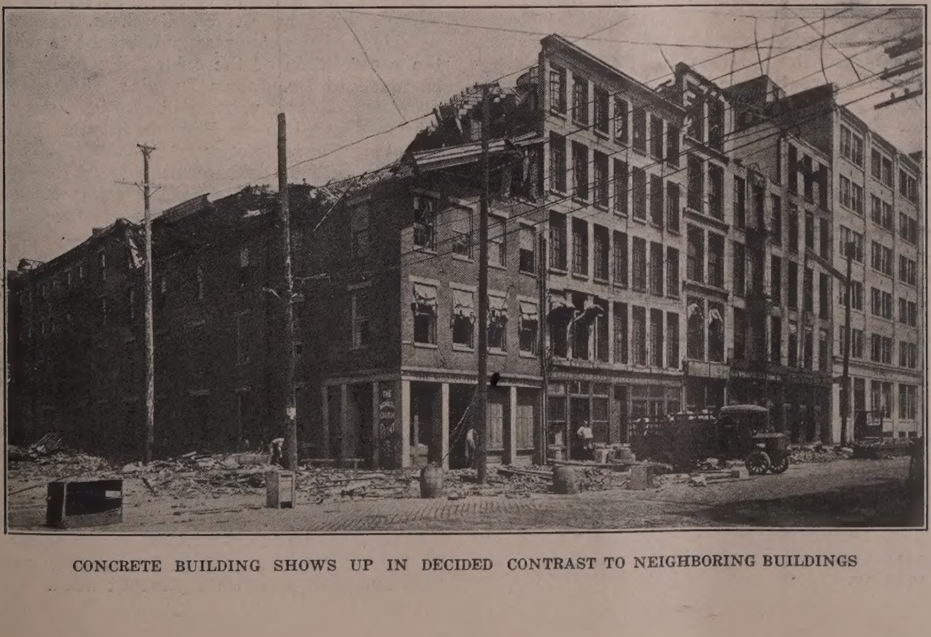
Section 4. That it shall be the further duty of said board to promote economy and efficiency in the municipal government. To perform such duty it shall conduct such investigations and studies from time to time of the efficiency of organization, administration, engineering and operating, accounting, finance and business procedure of the various departments and units of the municipal government and prescribe such standards and specifications necessary to secure economy and efficiency, as will enable it to pass with intelligence upon the various departmental estimates. The said board shall have power to inaugurate such changes and betterments as do not require council or legislative action.

Wastes Disposal Investigation Transferred to Cincinnati

The headquarters for the investigation of methods for the disposal of industrial wastes now being carried on by the U. S. Public Health Service was changed from Washington to Cincinnati, July 1. This change was made in order to co-operate with the Ohio River investigation, of which W. H. Frost, passed assistant surgeon, U. S. Public Health Service, is in charge. The industrial waste studies are under the supervision of Prof. Earle B. Phelps, professor of chemistry at the Hygienic Laboratory, Washington, D. C., with H. B. Hommon in charge of the Cincinnati and field offices. The staff consists of H. C. Colson, Jr., sanitary chemist in charge of tests at tannery, Luray, Va.; Walter E. Brown, sanitary bacteriologist in charge of tests at strawboard plant, Noblesville, Ind.; H. R. Crohurst, sanitary engineer, and W. D. Tiedeman and Emery J. Thierault, sanitary bacteriologists assisting in the studies of industrial wastes on the Ohio River watershed in the vicinity of Cincinnati.

Concrete Buildings Sustained Little Damage in Cincinnati Storm

The sixteen-story Ingalls Building, built of reinforced-concrete in 1902, emerged from the severe wind storm at Cincinnati, which was described in this journal July 17, with but a few panes of glass broken. The Lippincott Building, at Second and Main Streets, though in the direct path of the storm, suffered no damage whatever in the structural portion. About fifty panes of glass were broken and the parapet wall, which extended 8 ft. above the roof, was blown over. Buildings alongside of this structure suffered severely. Both of these buildings were erected by the Ferro Concrete Construction Company of Cincinnati, of which W. P. Anderson is the president.

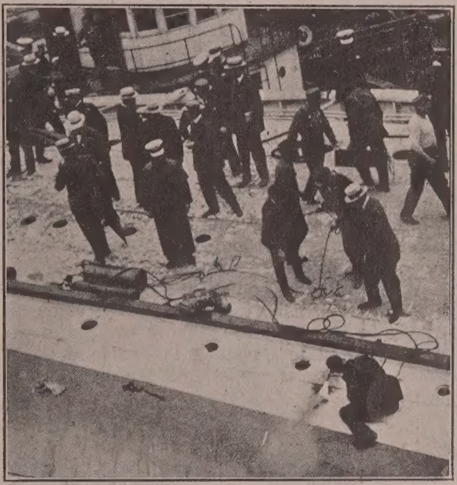


CONCRETE BUILDING SHOWS UP IN DECIDED CONTRAST TO NEIGHBORING BUILDINGS

Engineer's Warning Regarding "Eastland" Unheeded

J. D. York Wrote U. S. Official Aug. 3, 1913, Saying Boat Had Structural Defects—More than 1200 People Drowned in Chicago River

"You are aware of the condition of the SS. Eastland and unless structural defects are remedied to prevent listing there may be a serious accident." Thus wrote J. D. York, head of the Chicago firm of naval architects and engineers bearing his name. Mr. York's letter, written two years ago to the U. S. harbor master, Port of Chicago, was never answered. The letter is regarded as one of the most important pieces of evidence yet unearthed in tracing those responsible for the disaster.



OXYACETYLENE TORCH AIDS RESCUE WORK

Thirty minutes after the ill-fated steamer had capsized one of the editors of this journal was at the water's edge, having passed the police lines by presentation of his card. To attempt to describe the horror and results of the disaster would be futile and out of place in these columns. However, to the engineer, the cause and the means of rescue are of direct interest.

Improper Ballast Adjustment

"Improper ballast adjustment," caused the accident, according to a prominent Chicago engineer. "There was probably not sufficient ballast to compensate for the surging of the crowd of passengers and the shifting of ballast which resulted. According to evidence furnished me by a member of the crew, the ballast had been reduced in anticipation of an extra large number of passengers. When the boat started to leave the docks the passengers surged to the opposite side. This sudden surging caused a change in the center of gravity for which there was not enough ballast to compensate."

"Wanted, six men who know something about pulmotors," yelled a police sergeant from the side of the boat crowded with policemen. Not a man stepped out of the immense throng flocking the shores. It is to be noted that the policemen themselves were not acquainted with these powerful adjuncts for the saving of life.

Within a few minutes after the boat careened men were at work cutting holes through the hull in order that imprisoned passengers might be pulled through the apertures and saved. Oxyacetylene torches were immediately called for and placed at work. However, few were alive when they were reached, being either suffocated or drowned.

Powerful Lights Aid Night Work

From prow to stern the Eastland was illuminated the nights of July 24, 25 and 26 by ten high-power searchlights. Six of the illuminators were placed along the north edge of the Reid-Murdock plant across the river and four were strung across the channel. Poles erected on the side of the boat also carried lights. To light the interior of the boat electricians crawled through the openings burned with acetylene torches, earlier in the day. In the interior three divers were kept busy descending into the water that rose to within 20 ft. of what was the starboard side of the boat.

Investigations to place the responsibility for the disaster are now being conducted by Federal, State, county and city authorities. The Great Lakes Dredge & Dock Company, Chicago, has been commissioned to raise the boat. Divers working in and about the hull of the boat declared they could make no progress because of the intense blackness of the water and the large amount of debris blocking their way. Even powerful waterproof electric lights were of no avail. To release the scores of bodies known to be in the forward compartments of the boat, and the many more believed to be buried in the mud under the side of the vessel, the company sent heavy dredges to the scene to dig out channels in the river bottom of sufficient width to allow for pontoons. They plan to place a number of pontoons under the hull to raise the boat.

When all the bodies are taken from the steamer, it will be towed down the river and dynamite will be used to bring out bodies that are supposed to be stuck in the mud at the bottom of the river where the boat turned over.

Convict Labor for California State Highway System

The convict labor bill recently passed by the State of California, which becomes effective Aug. 8, is to be put in operation at once on highway construction in Humboldt and Mendocino counties. Out of this month's sale of State highway bonds $250,000 will be used for road work, employing convict labor. The first units constructed will be from Cummings to the south fork of Eel River, 33 miles, and from Miranda to Garberville, 15 miles. Three camps of 60 men each will be established, each consisting of a working force, policing force and a camp or cooking force. The convicts will do their own policing and there will be no guards. Each camp will be in charge of a superintendent, and a foreman will direct the road work.

Under the convict labor bill dual control is provided for in such camps; the disciplining of the men will be under the State board of prison directors and the management of the work will be under the highway commission. A modified honor system will be in effect, whereby the men will get certain credits for their work and behavior. The plan contemplates sending out on road work only those prisoners who are selected as worthy of such special trust.

Chicago Survey to Locate Mosquito Breeding Places

A survey of Chicago to discover the breeding places of mosquitoes will be made by the health department. The City Council, at its last meeting, authorized an appropriation of $1500 for this purpose. Dr. John Dill Robertson, health commissioner, has announced that as soon as the survey is completed the department will take steps to destroy the insects by the use of oil.

Work on New $5,100,000 Museum at Chicago to Be Started at Once

After twelve years of planning, a contract has been awarded to the Thompson-Starrett Company, Chicago, general contractors, for the construction of the new $5,100,000 Field Museum in Grant Park, Chicago. The contractors are starting work at once. About 4,000 of the 9,221 southern yellow pine piles which will form the foundation are already on their way to Chicago. A large part of the 315,000 cu. ft. of white Georgian marble, which will constitute the exterior of the building, is already on hand. Three years is given as an outside estimate for the completion of the museum. The contractors say it can be finished in two years.

The site of the new museum is on the newly made land east of the Illinois Central Railroad and just south of Twelfth Street. Raised on an elevation of 10 to 15 ft. above the level of Grant Park and surrounded by terraces, the building will form a feature of the city plan designed by the late Daniel H. Burnham. Graham, Burnham & Company, the architects, began working on the designs several years ago. Careful study and investigation of museum plans were made both in the United States and Europe.

When completed, it is said it will be the largest marble building in the world, and one of the largest museums. It will consist of three stories and basement and will cover an area of 700 by 350 ft. The floor area will be 670,000 sq. ft., of which 400,000 sq. ft. will be devoted to exhibition purposes. The remainder will be used for scientific laboratories, lecture halls, offices and a restaurant. The total floor area of the National museum at Washington is 465,000 sq. ft. and that of the American Museum of National History at New York is 438,000 sq. ft.

New England Waterworks Exhibits to Be Set Up Sept. 5 and 6

Sept. 5 and 6 are the days named for the setting up of exhibits for the New England Waterworks Association Convention to be held at the Hotel Waldorf-Astoria, New York City, Sept. 7, 8 and 9, according to rules issued by the Exhibit Committee, July 10. Twenty square feet of space will be allowed each exhibitor. An extra charge will be made for each additional square foot. Uniform signs will be issued by the Waterworks Manufacturers Association. The committee is now ready to receive applications for space, which should be addressed to Fred S. Bates, 180 Broadway, New York City.

American Society of Civil Engineers Issues Convention Program

The American Society of Civil Engineers has issued its program for its forty-seventh annual convention, to be held in San Francisco Sept. 16 to 18. Headquarters will be at the St. Francis Hotel. The convention will open at 10 a. m., Sept. 16. President Marx will deliver the annual address, after which the business meeting will convene. The afternoon will be left free for a visit to the Panama-Pacific International Exposition. At 6.30 p. m. an informal reception, dinner and dance will be held at Old Faithful Inn on the Exposition grounds. The morning session of Sept. 17 will be reserved for the adjournment of the business meeting if necessary. Otherwise there will be no special program.

About 3 p. m. there will be an excursion by special train to Del Monte, arriving there in time for dinner. The following day will be spent there. A golf tournament is planned for the morning, and for those not caring to participate in this there will be an automobile trip, with lunch at Pebble Lodges. The golf tournament will be continued during the afternoon and there will be dancing in the evening.

A train will leave about 8.30 a. m., Sept. 19, for Santa Cruz, where the party will take automobiles to "Big Tree" Basin. Lunch will be served at "Governors' Camp" and a return will be made to San José for dinner. The train will leave there for San Francisco about 8.40 p. m.

Those who are in the golf tournament and prefer this to the excursion on Sunday will stay during the day at Del Monte, leaving for San Francisco about 6 p. m. and arriving there with the party from San José.

Although the program has been arranged for those in attendance at the convention of the American society a general invitation is extended to all members of other societies and other members of the International Engineering Congress to participate in its various features.

Surveys for Denver Municipal Waterworks Started

The Denver Public Utility Commission entered into a contract, July 20, with the Van Sant-Houghton Company, engineers and contractors, to make surveys, foundation borings and working plans for a municipal water system for Denver, in accordance with the wish of the citizens when a bond issue of $8,000,000 was voted five years ago. All efforts up to now to sell these bonds have been futile, bankers in Chicago and other Eastern cities advising strongly against their sale so long as there was such serious litigation between the existing company and the municipality.

The Van Sant-Houghton Company is a San Francisco firm which has an office in Denver to care for its contracts as Western representatives of the Unit Construction Company, St. Louis, for the umbrella trainsheds and the subways of the Union Station. Bonds to the extent of $150,000 are to be paid for in cash by the engineering firm and the cash is to be turned back to it in payment for the report, investigations and plans, which are to be completed in ten months. Mr. Houghton states that several parties will be recruited in Denver and placed in the field immediately. A. Lincoln Fellows, chairman of the commission, is of the opinion that the low costs obtained by the pneumatic concrete mixer equipment with which the company has been lining the tunnels of the Los Angeles Aqueduct and the Mile Rock sewer in San Francisco will reduce the tunneling cost 50 per cent below the original estimate.

No Evening Meetings Will Be Held at Engineering Congress

The opening session of the International Engineering Congress at San Francisco will be held at 10 a. m., Sept. 20. There will be general addresses of welcome and responses, and an address by Gen. G. W. Goethals, honorary president of the congress, subsequent to which the presentation of the John Fritz Medal will be made to Dr. James Douglas. The afternoon session, at 2 p. m., will also be a general session devoted to the Panama Canal.

During the remainder of the week sectional meetings will be held morning and afternoon, ending with a brief general closing meeting Saturday, at 11.30 a. m. No meetings of the congress will be held in the evening.

The committee on local affairs plans a general reception and ball for the evening of Sept. 20, a subscription dinner for the evening of Sept. 24 and special attentions for visiting ladies, including, presumably, an automobile drive in Golden Gate Park, an excursion by boat on the Bay, an excursion to Mount Tamalpais and a lawn party.

Special arrangements will also be made for participants in the meetings to see under the best conditions certain exhibits at the Exposition in which engineers are likely to take a particular interest, and, in general, every effort will be made by the committee of management of the congress to provide for visiting members and their families a pleasant week.

Will Build Annex to Polk Street Station, Chicago

The Chicago & Western Indiana Railroad has been granted, after more than a year's consideration by the Chicago City Council, permission to build an annex to the Polk Street Station. The ordinance permits the road to lay two tracks across Plymouth Court at Taylor Street. Opposition to the ordinance came under the following heads: Danger to citizens of having tracks at street level; contention that the ordinance was a terminal matter and that the railroad did not intend to give up its tracks at the end of the five-year grant. It was sought to compel the railroad to surrender street and alley space which the city contended it held illegally.

Materials to Receive Special Attention at Engineering Congress

The materials of construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held at San Francisco, Sept. 20-25. Volume 5 of the transactions will include about 25 papers covering the following subjects: Timber resources, preservative methods, brick and clay products, life of concrete structures, aggregates for concrete, waterproofing, volume changes in concrete, life of iron and steel structures, special steels and testing of metals, full sized members and of structures.

Personal Notes

R. H. Pembroke has resigned from the office of chief engineer of the Coal & Coke Railway.

John A. Bruce has been appointed city engineer of Omaha, Neb., succeeding Watson Townsend.

Walter C. Eberhard has been reappointed assistant in civil engineering on the instructing staff of the Massachusetts Institute of Technology.

William Wales, irrigation engineer, of Woodland, Cal., has been retained to do the preliminary work in connection with the proposed Southern Lassen Irrigation District, at Doyle, Cal.

George W. Simons, Jr., Howard C. Thomas and Andrew N. Wardle have been appointed assistants in civil engineering on the instructing staff of the Massachusetts Institute of Technology.

Edward J. Kelly, assistant chief engineer of the Sanitary District of Chicago, has been appointed by Governor Dunne of Illinois as one of the five members of the Illinois Waterway Commission.

Joseph E. Love, formerly structural engineer for the Chicago, Milwaukee & St. Paul Railway, at Butte, Mont., has been appointed engineer for the South Dakota Board of Railroad Commissioners.

J. Franklin Diggs, Jr., resident engineer for the southern division of the bureau of sanitary engineering of the Department of Health of the State of Maryland, has established his headquarters at Hyattsville.

Mayo Tolman, formerly assistant engineer for the Department of Health of the State of Maryland, has been appointed director of the division of sanitary engineering of the West Virginia State Board of Health.

Ray L. Jaeger has been appointed inspector in the U. S. Engineer office at Grand Rapids, Mich. This office has charge of the harbor and river improvement work along the east shore of Lake Michigan.

J. O. Jones has been appointed assistant professor of hydraulics at the University of Kansas. The announcement of this appointment was made in these columns, July 10, but the name was erroneously given as J. O. James.

Edward E. Krauss, for the past four years secretary of the American Concrete Institute, has been appointed district sales manager, at Philadelphia, for the Penn-Allen Cement Company of Allentown, Pa. His office is in the Widener Building.

Kenneth C. Grant, for the past two years connected with the Morgan Engineering Company, at Dayton, has been appointed as delegate to represent the State of Ohio at the Fifth National Drainage Congress at San Francisco, Sept. 17 to 20.

Edward Flad & Company, consulting engineers, of St. Louis, have been retained by the Murphysboro (Ill.) Waterworks, Electric Light & Gas Company on the engineering work in connection with the installation of a filtration plant in that city.

B. R. Cloyd, formerly engaged in special hydrographic work for the U. S. Reclamation Service, and previous to that, city engineer of Yuma, Ariz., is now connected with the engineering forces of the Copper Queen Consolidated Mining Company, Bisbee, Ariz.

John W. Hill, consulting engineer, of Cincinnati, has been retained by the conservancy commissioners of Miami, Clark and Shelby counties, Ohio, to prepare plans to be used in opposition to those prepared by the Morgan Engineering Company for conservancy work in that district.

Schuyler A. Obenshain, who has been engaged in contracting work at Bluefield, W. Va., during the past year and a half, has been appointed superintendent of construction for the Tangier Manors Corporation, on the improvements that company is making at Tangier, L. I., N. Y.

F. D. Cosner has been appointed engineer maintenance-of-way of the Coal & Coke Railway, with headquarters at Gassaway, W. Va. He will also assume the duties of the chief engineer, that office having been abolished with the resignation of R. H. Pembroke, which is noted elsewhere in these columns.

C. E. Smith, who recently resigned from the office of assistant chief engineer of the Missouri Pacific-Iron Mountain system to engage in private practice as consulting engineer, as noted in these columns, June 5, has been appointed consulting engineer of the Department of Public Utilities of St. Louis.

Milo R. Maltbie, formerly a member of the Public Service Commission, First District, New York State, and recently chairman of the valuation committee of the National Association of Railway Commissioners, has been appointed a member of the advisory board to C. A. Prouty, director of the valuation division of the Interstate Commerce Commission.

W. E. Moore has resigned from the office of vice-president and general manager of the West Penn Traction Company to devote his whole time to private practice as consulting engineer, with offices at Pittsburgh. He will engage in power development, transmission and railway work, and will also undertake appraisals, reports in connection with public service regulation and advisory work on public utility management.

Robert S. Brown has opened offices in the Legal Building, Asheville, Tenn., for the purpose of practising as a civil engineer and surveyor. He will engage particularly in topographic, highway, industrial railroad, county and municipal work. Mr. Brown was graduated from Trinity College, Durham, N. C., in 1908. Since then he has engaged chiefly in railway location and construction in various Western and Southern States.

Philip P. Farley, who was consulting engineer to the New York State Highway Department during the administration of Governor Glynn, has opened offices at 103 Park Avenue, New York City, for the purpose of continuing his practice as consulting engineer. Mr. Farley was graduated from Cooper Union in 1893. He served as chief assistant to the city engineer of Atlantic City, N. J., from 1896 to 1899 and as deputy fire commissioner of New York City in 1911. He was president of the Jamaica Bay Improvement Commission previous to his appointment as consulting engineer to the New York State Highway Department in 1914.

Theodore E. Seelye has resigned from the office of division engineer of the Water Supply Commission of Pennsylvania to engage in private practice with Farley Gannet, formerly engineer of that commission, whose resignation to enter the consulting field was noted in these columns last week. Mr. Seelye joined the engineering forces of the water supply commission in 1913. Previous to that he was connected with the hydraulic design department of the Electric Bond & Share Company of New York on hydroelectric work and with the U. S. Engineer on the construction of jetties and fortifications at the mouth of the Mississippi River and of navigation locks in Louisiana.

H. A. Kipp, who has been connected with the Office of Drainage Investigations, U. S. Department of Agriculture, for the past nine years, has resigned to engage in private practice as consulting engineer, specializing in drainage work, with office at the Southern Pacific Building, Houston, Tex. Among the drainage projects with which Mr. Kipp has been connected are the Everglades work in Florida, the St. Francis River project in Arkansas, the Toisnot Swamp project in North Carolina and the Tuscumbia and Belzoni projects in Mississippi. He recently completed a report and plan for the drainage of the entire area of Jefferson County, Texas, for the U. S. Government.

John A. O'Connor, formerly engineer in charge of terminal construction, New York State Barge Canal, and Arnold G. Chapman, consulting engineer, of Albany, N. Y., have been appointed executive engineers for the Flood Abatement Commission of Olean, N. Y. Mr. O'Connor has been engaged in engineering work since 1896, principally on the forces of the State of New York, on river improvement, highway and canal work. Mr. Chapman was graduated from Union College in 1906, and has also done most of his work in the office of the State engineer of New York. He was assistant to M. W. Williams, engineer in charge of the excavation and straightening of the channel of Neversink River, in the autumn of 1905, and deputy State engineer and surveyor, in 1910.

C. M. Rogers, consulting engineer of Daytona, Fla., has been appointed engineer for the proposed 1⅛ miles concrete bridge across the Indian River at Cocoa, Fla. Mr. Rogers was graduated from Rensselaer Polytechnic Institute in 1903 and was assistant engineer and division engineer on the construction of the Key West extension of Florida East Coast Railway from 1905 to 1907. He served for a brief period with the Florida Coast Line Canal & Transportation Company in the early part of the latter year, then returned to the Florida East Coast Railway as resident engineer on the Long Key viaduct. He succeeded to the business of the engineering firm of D. D. & C. M. Rogers of Daytona, in 1913, and, in 1914, was engineer in charge of the construction of a complete sewerage system for the board of public works of that city.

Obituary Notes

John G. Scurry, a well known civil engineer of Seattle, Wash., died in that city, July 14. He served under General Dodge on the original location of the Southern Pacific Railway over the Mojave Desert and was one of the locating engineers on the first transcontinental railroad of the Union Pacific. The later years of his life were spent in railroad work in Alaska.

Sir Sandford Fleming, who was an important factor in the building of the Canadian Pacific Railway, died at Halifax, N. S., July 22. He was born in Scotland in 1827 and went to Canada, where he joined the forces of the Northern railway, in 1845. He attained the grade of chief engineer of that road twelve years later. In 1863 he made the surveys for the Intercolonial railway, which was subsequently built under his direction. He was chief engineer of the Canadian Pacific from 1871 to 1880, during the period of location and construction. The latter years of his life were confined principally to scientific research. He wrote several books on technical subjects, among them being "Time and Its Notation," "Memoirs of Universal Time and a Prime Meridian for All Nations" and "The New Time Reckoning."

Civil Service Examinations

United States.—An examination for junior civil engineer, Engineering Department, will be held at the principal cities of the country, Aug. 25 and 26. Candidates must be twenty-one years or over and must have had at least four years' experience in engineering work, or have been graduated from a technical school of recognized standing. It is further announced that eligibles from this examination who are unmarried, between twenty-one and twenty-nine years of age and graduates from an approved technical school, will have an opportunity to qualify for the examination for commissions as second lieutenants, Corps of Engineers, U. S. A., to be held by the War Department, on or about Oct. 25, 1915.

Examinations for senior drainage, drainage and junior drainage engineers, Department of Agriculture, salaries ranging from $2,220 to $3,000, from $1,800 to $2,100 and from $960 to $1,620 respectively, are to be held at the principal cities, on Aug. 17 and 18. The duties of these positions will consist of making surveys, preparing plans and reports upon drainage projects, collecting technical data, and conducting original investigations. Applicants for the position of senior drainage engineer must be graduates from an approved engineering college and must have had five years' experience in drainage work, or, if not graduates, nine years' experience; for the position of drainage engineer, must be graduates and have three years' experience, or have seven years' experience in drainage work, and for the position of junior drainage engineer, must be graduates, or have four years' experience in civil engineering work.

Application for any one of these examinations should be made at once to the Civil Service Commission, Washington, D. C., asking for form 1312 and stating the title of the examination for which the form is desired. Persons interested in the examination to be held for commissions as second lieutenants, Corps of Engineers, U. S. A. should apply as well to the adjutant general, War Department, Washington, D. C.

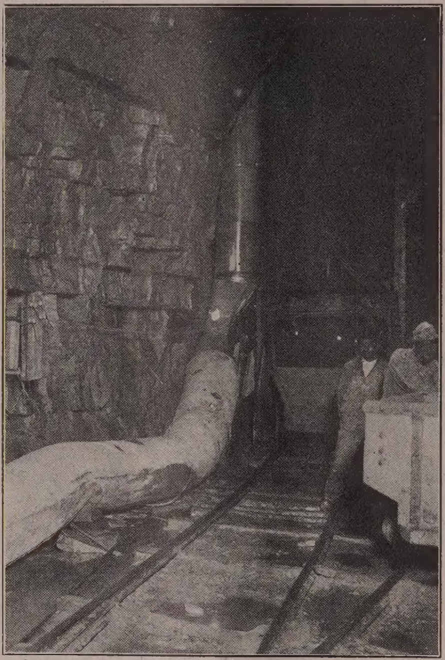
Examinations Previously Announced

Date		See Eng. Record.
Aug.	6—Tracer, salary from $600 to $900 a year; rodman, salary $800 a year; Philadelphia.	
Aug.	9-12—Draftsman, surveys, salary from $1,200 to $1,500 a year; Philadelphia......	
Aug.	10-13—Draftsman, highways, salary from $1,200 to $1,500 a year; Philadelphia......	July 24
Aug.	17-18—Senior, Grade 1 and 2, and junior land appraisers, salaries from $2,700 to $3,600, from $1,800 to $2,400 and from $900 to $1,500 respectively; United States	July 24
Sept.	15—Aid, U. S. Coast and Geodetic Survey. Draftsman and junior engineer, U. S. Engineer Department	July 3
Oct.	13—Aid, U. S. Bureau of Standards. Civil Engineer and Draftsman. D[illegible] Draftsman, Navy [illegible] Department. Engineer, Indian Service..	July 3

Canvas Air Pipe Not Damaged by Tunnel Blasts

Early in the construction of the Mill Creek Sewer in St. Louis the contractors conceived the idea of having the pipe they used to carry air to their headings made of some sort of airtight, waterproof fabric, which would be flexible, light and easy to handle during blasts. The metal pipe usually used is hard to handle quickly, and each time a blast is made it must be taken down and carried back from the heading so as to escape damage from the explosion.

To supply the contractors' demand the Bemis Bag Company of St. Louis, developed a tubing which they call "Flexoid." It is made of 9-oz. canvas, waterproofed and made airtight by having a solution of asphalt and rubber forced into it. The tubing can be obtained in 10, 12, 16 and 24-in. diameters and comes in 100 and 200-ft. rolls.

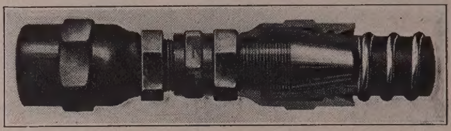


CANVAS AIR PIPE FOR TUNNEL WORK

Whenever blasts are to be made the air is shut off and the tube collapsed. Being light in weight and not bulky one man can quickly roll up 100 ft. of the tube and carry it out of the danger zone. The tube can be patched when necessary with a new piece of canvas and a little shellac. Connection between pipe sections is made by means of a short sleeve of metal pipe with two bands which clamp on to the tubing. A 16-in. size tubing handles 10,000 ft. of air per minute. The accompanying photograph shows the pipe in use on one of the sections of the Mill Creek Sewer. Thomas Connor & Son, one of the several contractors who are using the new tubing on this particular job, are carrying air from 500 to 1600 ft. The new fabric is being used for temporary water diversion in bridge and culvert work. It is also furnished flat and in large sheets for covering new concrete.

Non-Reduction of Area Is a Feature of New Hose Coupling

An air, steam or water hose coupling, so designed as not to decrease the area of the hose connection, has recently been placed on the market. The malleable iron hose socket is sufficiently corrugated on the inside to provide a positive grip when the hose is expanded, and by simply screwing the steel taper expander into the socket the hose is forced outward and into position. The area of the opening in the steel taper expander is the same as that of the hose, thus eliminating contraction. The hose connection requires only one or two turns with an ordinary hand wrench. The coupling is manufactured in all standard sizes by the National Hose Coupling Company, Peoples' Gas Building, Chicago.

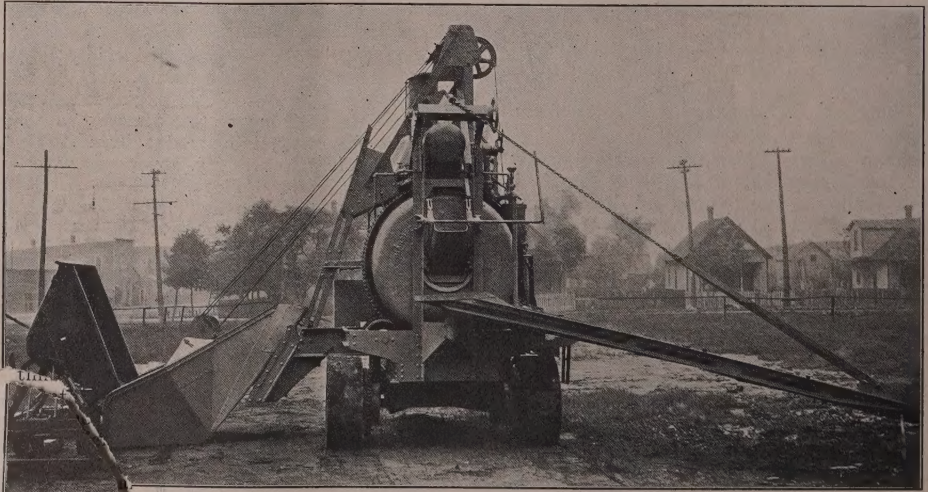


AIR, STEAM OR WATER HOSE COUPLING

Paving Mixer Has 40 Cubic Feet Capacity, and Loads from the Side

Exceptionally large capacity and ability to load from the side for use with industrial equipment are two prominent features of the latest model paving mixer to be placed on the market. The machine has a capacity of 40 cu. ft. of loose material and was designed for use on concrete road jobs where industrial tracks parallel the road. The first mixer to be placed in service is now working for Runyan & Ackerman of La Porte, Ind., contractors in charge of the construction of 13 miles of concrete road on the Lincoln Highway near La Porte.

Industrial cars holding 36 cu. ft. of material, or one batch for the mixer, are run on a track paralleling the road and as the mixer has its skip on the side they can dump directly into it. Concrete is distributed, by three ports in the bottom of the mixer's 15-ft. chute, at different points without shifting the machine. This new paver, which is said to be the largest capacity paving mixer and the only side loader yet to be placed on the market, is manufactured by the Marsh-Capron Manufacturing Company, Chicago.



CONCRETE DISTRIBUTED FROM THREE PORTS IN BOTTOM OF THIS MIXER